Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

	)	
In the Matter of	)	
	)	MB Docket No. 12-217
Cable Television Technical and Operational	)	
Requirements	)	

COMMENTS OF THE NATIONAL CABLE & TELECOMMUNICATIONS ASSOCIATION

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INTRODUCTION

The National Cable & Telecommunications Association ("NCTA"),[1] by its attorneys, submits its comments in the above-captioned proceeding. The goal of this proceeding is to "modernize and modify the Commission's proof-of-performance rules and basic signal leakage performance criteria"[2] to take into account cable systems' provision of digital signals. The proceeding aims to adopt rules that require cable systems to demonstrate that they provide digital signals of a specified technical quality and to update the Commission's signal leakage rules to help protect aeronautical distress and safety frequencies against interference from digital signals.[3]

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[1] NCTA is the principal trade association for the U.S. cable industry, representing cable operators serving more than 90 percent of the nation's cable television households and more than 200 cable program networks. The cable industry is the nation's largest provider of broadband service after investing over $185 billion since 1996 to build two-way interactive networks with fiber optic technology. Cable companies also provide state-of-the-art competitive voice service to more than 23 million customers.

[2] NPRM at ¶ 1.

[3] *Id*. at 3.

Congress in the 1992 Act directed the Commission to "prescribe regulations which establish minimum technical standards relating to cable systems' technical operation and signal quality," and to "update such standards periodically to reflect improvements in technology."[4] As the Notice recognizes, much has changed in cable technology since the Commission last examined its signal quality rules in 1992. These "improvements in technology" warrant taking a fresh approach to mandatory digital signal quality testing.

Most significantly for these purposes, the digital technology in widespread use in cable systems today provides consistently better signal quality than the analog signals of 1992. Moreover, cable operators throughout the country face competition from all-digital multichannel video programming distributors, providing a powerful non-regulatory marketplace incentive for cable operators to ensure the high quality of their system performance on an on-going basis. In light of these developments and consistent with Executive Order 13579, which encourages reassessment of regulations that may be outmoded or excessively burdensome,[5] the Commission should avoid replicating in the digital world the semi-annual proof-of-performance testing that arose for reasons unique to analog signal carriage. Instead, compliance should be enforced through certifications and complaints, rather than through unnecessary mandatory prescribed testing.

Additionally, complying with the signal leakage rules that protect aeronautical safety remains important in the digital world, but burdensome new rules are unnecessary to achieve this goal. The Commission should adopt rules that allow cable operators to demonstrate adherence to

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[4] 47 U.S.C. § 544(e). Local franchising authorities are permitted to consider "the quality of the operator's service, including signal quality" in the franchise renewal process. 47 U.S.C. § 546) (c)(1)(B).

[5] Executive Order No. 13570, § 2, 76 Fed. Reg. 41587 (July 11, 2011) ("*Retrospective Analyses of Existing Rules.* (a) To facilitate the periodic review of existing significant regulations, independent regulatory agencies should consider how best to promote retrospective analysis of rules that may be outmoded, ineffective, insufficient, or excessively burdensome, and to modify, streamline, expand, or repeal them in accordance with what has been learned.").

the signal leakage requirements without requiring the purchase of costly new test equipment. The new rules can accomplish this goal by relying on existing leakage monitoring and measurements, adjusted to reflect modified digital signal leakage parameters.

I. THE COMMISSION SHOULD NOT REQUIRE BURDENSOME PROOF-OF-PERFORMANCE TESTING TO DEMONSTRATE COMPLIANCE WITH THE DIGITAL SIGNAL QUALITY STANDARDS

The Notice proposes to "adopt the standard established by the Society of Cable Telecommunications Engineers ('SCTE'), the SCTE 40 Digital Cable Network Interface Standard, as the signal quality standard for QAM-based digital cable systems" and to "require testing and documentation that demonstrates compliance with the metrics associated with this standard."[6] The cable industry has long operated under the SCTE 40 specifications.[7] The FCC in 2003 adopted rules that require digital cable systems with an activated channel capacity of 750 MHz or greater[8] to adhere to this standard (and encourages even digital systems with more limited capacity of 550 MHz to do so) "to ensure that consumer expectations regarding the functionality of unidirectional cable televisions and products are met."[9] Thus, we agree that SCTE 40 is the right starting point for technical standards that will ensure that cable customers receive a good quality digital signal.

However, designing a system to comply with the technical specifications outlined in SCTE 40[10] and requiring *proof* that the system complies in the highly detailed and specific

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6 Notice at ¶ 10.

7 Society of Cable Telecommunications Engineers, Engineering Committee, Digital Video Subcommittee, American National Standard, ANSI/SCTE 40 2011 (hereinafter "SCTE 40").

8 Second Report and Order and Second Further Notice of Proposed Rulemaking, 18 FCC Rcd 20885, 20894 (2003).

9 *Id*. at 20894 n. 41.

10 FCC rules already make operators "responsible for insuring that each such system is designed, installed, and operated in a manner that fully complies with the provision of "the technical standards in Subpart K." 47 C.F.R. § 76.601(a). Operators will have an ongoing responsibility – when conducting installs or repairs – to ensure that SCTE 40 is being met.

fashion contemplated by the Notice are two entirely different things. The Notice assumes that operators not only must adhere to these digital signal quality standards but also must *prove* they are doing so through semi-annual testing and documentation. It states without explanation that "testing and documentation is essential to ensuring compliance and permitting effective enforcement of our proof-of-performance rules."[11]

There are several reasons why FCC-prescribed testing of digital signals is unnecessary. First, unlike 1992, where a "pattern of technical problems with [analog] cable service"[12] led to regulation, the quality of cable television digital signals has not been an issue despite the fact that (1) the FCC has required operators of 750 MHz or greater systems to adhere to these digital technical standards since 2003; and (2) no mandatory testing regime has been in place.

Second, the inherent robustness and reliability of digital signals makes testing far less necessary. There may have been a reason to require all-analog systems to be tested at least twice a year (at intervals not to exceed seven months) to gauge, for example, the effect of temperature extremes on devices in the field. Systems in 1992 typically used multiple amplifiers in the trunk and feeder plant to maintain analog signal quality, and those amplifiers could introduce excessive noise and distortions in the picture delivered to those homes located at the end of the amplifier cascade. But cable system architecture has vastly improved over the ensuing twenty years. Even with respect to analog technology, the introduction of hybrid fiber/coaxial distribution has reduced the need for amplifiers, resulting in fewer active devices in the field. And digital

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[11] Notice at ¶ 11.

[12] The Commission's 1990 Report to Congress identified cable service technical quality as an issue, finding that "there is a pattern of technical problems with cable service." *Cable Television Technical and Operational Requirements; Review of the Technical and Operational Requirements of Part 76, Cable Television*, 7 FCC Rcd 2021at ¶ 5 (1992).

technology, with its error correction capabilities, provides a much more consistent and robust signal along the distribution plant.

Third, modern cable television distribution system architecture essentially divides the network into numerous technically-independent mini-networks or "nodes", each typically serving at most a few hundred customers. The performance of the distribution plant serving each node is essentially independent of the performance of other nodes, so that performing a full proof-of-performance test on a few nodes provides little information about the signals delivered to customers served from other nodes. And it would be a practical impossibility to run such tests on all the nodes in a network.

Fourth, technological advancements not only provide better signal quality but also enable superior methods for monitoring system performance. The Commission stated in adopting proof-of-performance requirements that its "[a]im is not to generate marginally useful measurement data for ourselves, but to encourage each cable operator to engage in systematic performance checking and preventive maintenance."[13] Decades later, proof-of-performance testing would only generate marginally useful data and has very little to do with the ultimate goal of protecting consumers. Operators already routinely deploy a variety of methods to remotely check on the health of their systems on an on-going basis and may obtain much more granular information about signal quality through telemetry than would be obtained through FCC-prescribed testing. This type of on-going system monitoring is used for preventive maintenance, finding and fixing potential problems before they become visible to the customer. Such monitoring thus cuts down on customer service calls and reduces the need for expensive truck

[13] Amendment of Part 74, Subpart K, of the Commission's Rules and Regulations Relative to Community Antenna Television Systems: And Inquiry Into the Development of Communications Technology and Services to Formulate Regulatory Policy and Rulemaking and/or Legislative Proposals, 36 FCC 143, 200 (1972). Even then, tests were only required to be performed once each calendar year.

rolls to homes. In fact, the Commission has previously recognized that cable operators have strong economic incentives to reduce truck rolls, incentives that have positive effects on reducing vehicle traffic, energy use and pollution.[14]

The competitive environment in which cable operators provide video service has also dramatically changed. Unlike 1992, operators today face vigorous competition from MVPDs looking to attract cable customers dissatisfied with the quality of their cable service. Cable competes with all-digital MVPDs, such as DirecTV and Dish, who tout the quality of their digital service[15] (and have no corresponding burdensome FCC-imposed testing obligations).[16] Many cable customers also have the option of subscribing to all-digital phone company MVPDs. Not surprisingly, cable operators routinely publicize the benefits of digital technology, including its outstanding picture quality, lest they lose customers to their competitors.[17] These marketplace incentives ensure that cable systems engage in on-going measures to maintain good quality signals, regardless of any regulatory mandate.

In short, circumstances today differ significantly from those that led the FCC to adopt semi-annual proof-of-performance testing twenty years ago. And these "improvements in technology"[18] warrant taking a fresh approach. Mandatory proof-of-performance testing would constrain innovation in how operators evolve the on-going monitoring of their systems for signal quality. And it would needlessly force operators to deploy extra manpower, test equipment, and

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[14] *See* Basic Tier Encryption Order, 27 FCC Rcd 12786 at ¶ 13 (2012).

[15] *See, e.g.*, *Time Warner Cable, Inc., v. DirecTV, Inc.*, 407 F. 3d 144 (2d Cir. 2007) (appeal from injunction) (TWC sued DirecTV for claiming its HD picture quality was superior to cable's HD picture quality.).

[16] *See* 47 C.F.R. § 25.211 (Once a video test transmission has been performed, no further tests are required "if subsequent transmissions are conducted using exactly the same parameters as the initial transmission.").

[17] http://www.comcast.com/Corporate/Learn/DigitalCable/HD.html; http://www.timewarnercable.com/en/residential-home/tv/plans.html; http://ww2.cox.com/residential/northernvirginia/tv/high-definition.cox; http://www.charter.com/tv/hd; http://www.optimum.com/digital-cable-tv/hdtv/.

[18] 47 U.S.C. § 544(e).

other resources while gaining little if any knowledge about system performance or enhancing the quality of a customer's experience.

Accordingly, the Commission should not require proof-of-performance testing for digital signals.[19] Operators instead should be allowed to show compliance with the digital technical standards by certifying that the system is designed to provide good quality signals per SCTE 40 and that the system complies with those technical standards (and is subject to reasonable periodic maintenance and testing to ensure its continued proper operation). This type of certification is entirely consistent with other FCC rules, such as those recently enacted to implement the CALM Act.[20] Those rules only prescribe testing in the absence of such a certification or in response to a complaint.[21]

The FCC should adopt a similar approach for ensuring compliance with SCTE 40. With respect to complaints, operators already notify customers about the process for complaining about signal quality.[22] Customers with digital signal quality problems, just like those with analog signal quality issues, can have those complaints resolved in the same manner.

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[19] Canada adopted a similar approach. It no longer requires proof-of-performance testing. *See* http://strategis.rc.gc.ca/eic/site/smt.gst.nsf/eng/sf08414.html#TCO2_12.

[20] Those rules permit operators to certify rather than provide detailed test results. *See* Implementation of the Commercial Advertisement Loudness Mitigation (CALM) Act, 26 FCC Rcd 17222 (2011) at ¶ 29. ("Any cable operator that "installs, utilizes, and maintains in a commercially reasonable manner the equipment and associated software in compliance with regulations issued by the Federal Communications Commission… shall be deemed in compliance.").

[21] See *id.* at ¶ 35 (requiring spot checking of non-certified networks).

[22] *See* 47 C.F.R. § 76.1713 (operators must establish "a process for resolving complaints from subscribers about the quality of the television signal delivered.") and *id.*, § 76.1602(c) ("Subscribers shall be advised of the procedures for resolution of complaints about the quality of the television signal delivered by the cable system operator, including the address of the responsible officer of the local franchising authority.").

II. THE COMMISSION SHOULD ADOPT THE INDUSTRY-DEVELOPED SCTE 40 STANDARD, WITH MODIFICATIONS, FOR DIGITAL SIGNAL QUALITY

A. SCTE 40 Was Not Intended to Be Used as a Testing Standard

As a general matter, we agree with the Notice's proposal to adopt the industry-developed SCTE 40 standard for determining a good quality digital signal for QAM-based systems. However, if the Commission decides to require proof-of-performance testing, it would be inappropriate to incorporate SCTE 40 wholesale in the technical standards rules for testing purposes. In some cases, the standards are not applicable to measurements; in other cases, testing itself is problematic, requiring specialized equipment or service disruptions; in yet other cases, tests can be performed more easily at the headend than in the field without compromising the legitimacy of test results. Accordingly, if SCTE 40 is to form the basis of any testing obligation, the Commission should refine its approach to reference only those sections that are appropriate for digital signal measurement and documentation.

Attachment A details our suggested revisions to the proposed rules contained in the Notice to reflect the changes we believe more accurately reflect the intent of SCTE 40 relating to performance of digital channels. As described below, some of these changes are warranted even if the FCC simply adopts SCTE 40 as the technical requirement without a corresponding proof-of-performance rule; if a testing requirement is adopted, the Commission should make certain additional changes to the proposed rules.

- The references to "QAM *or similar video channels*" throughout the proposed rules should be changed to delete the reference to "similar video channels" because SCTE 40 *only* applies to QAM-based Forward Application Transport Channels.
- Proposed Sec. 76.601(b)(3) reverses the level-related and the selected-channel requirements. The reference to Sec. 76.601(c)(*1*), which references SCTE 40, Table 4 should be changed to 76.601 (c)(*2*) – adjacent channel and nominal power levels. Only the latter standard would be required to be measured on each channel. This change would then parallel the existing analog testing requirements where absolute and relative signal levels must be measured on every channel at every test point,

while performance tests are conducted on only select representative channels, and would be consistent with the FCC's conclusion to require that operators test only a subset of channels.[23]

- Proposed Sec. 76.601(c) references Tables 4, 5 and 6 of SCTE 40. However, Tables 4 and 6 both include analog parameters in addition to digital performance parameters. Specifically, Table 4 rows 4, 5, 6, 7, 12 and 14 contain requirements for analog video performance that overlap requirements for analog technical standards already incorporated in the rules. Table 6 row 13 contains requirements that overlap a preexisting requirement in Section 76.605(b). To avoid confusion, the rules should reference only the *digital* parameters and not overlapping *analog* parameters.
- Certain aspects of SCTE 40 are meant as design parameters and are generally not quantifiable through testing. For example, the Commission requires proof-of-performance testing, it would be inappropriate to include Table 4 rows 1 and 2 in the testing requirements. Row 1 simply mandates the industry-standard channel spacing, while row 2 simply lists the industry-standard frequency usage. Neither is a performance-related standard.
- Table 4 row 3 addresses the parameter for transit delay from the headend to the most distant customer. The UDCP rules (Section 76.640(b)(1)(b)) provide that this requirement is not mandatory. The digital technical requirements should adopt a parallel exemption making clear that it also is not mandatory for purposes of digital technical standards.
- Table 4 row 11 relates to "phase noise." Testing of phase noise requires the QAM modulator's digital modulation to be disabled or removed so that the unsuppressed carrier at the channels center frequency can be measured. This would unnecessarily force operators to disrupt service to customers. This could potentially affect multiple services that may be transported on a single QAM channel. Moreover, equipment commonly used by cable operators cannot perform this measurement. If the Commission were to require testing, operators would be forced to use an expensive laboratory-grade instrument not typically available at the cable system. This type of disruption and burden should not be required. Since phase noise is primarily generated by oscillators used in headend signal processing and modulation equipment, the phase noise performance of a QAM signal will typically not change from its performance at the QAM modulator output. In lieu of any testing requirement, operators whose systems do not include any RF frequency changing equipment between the last point of modulation and the input to the terminal equipment should be permitted to rely on manufacturer specifications for the modulation equipment to demonstrate compliance with the phase noise standard.
- Table 4 row 8 relates to AM hum modulations. As described in the SCTE Measurement Recommended Practice, while testing for hum modulation can be made without service interruption, testing for compliance with this parameter on digital channels is complex. It would require an advanced spectrum analyzer, including high logarithmic resolution, internal data averaging capability, the ability to store at least

[23] Notice at ¶ 11.

1000 measurements, and the capability to transfer the sample data to a computer for offline spreadsheet analysis.[24]

- Hum modulation can occur at the headend, but is more likely to occur while passing through the distribution system. And aberrations in the distribution system that cause hum modulation are likely to affect all transmitted signals similarly. Accordingly, if testing is required, the FCC should permit operators to measure hum on either a single channel using the nearest analog signal or on a single channel using a single unmodulated carrier, as is now permitted for analog signal testing per § 76.605(a)(10).
- Table 6 rows 10-12 and 16 contain criteria addressing downstream data, which the Notice proposes excluding from testing.[25] Row 13 contains criteria that overlap a requirement in § 76.605(b)(4)(i). These criteria should be excluded from proposed Section 76.605(c).

B. The Commission Should Not Adopt Rules Regarding Subjective Picture Quality

The Notice suggests that a signal may be of "good technical quality" insofar as it complies with SCTE 40 and provides a highly reliable signal but still not provide a "good visual quality" at a customer's home due to excessive re-compression or the introduction of errors in signal processing equipment at the headend. The Notice thus asks whether to consider "qualitative measures to assess consumer perceptions of video quality."[26] Such a proposal suffers from several flaws and should not be adopted.

Operators use digital multiplexing or content re-encoding at the headend[27] based on acceptable industry practices and vendor guidelines in order not to negatively affect the quality of the video service. So long as the distribution plant itself is operating in accordance with the parameters established in SCTE 40, the quality of the signal sent from the headend should not be negatively affected and a good quality signal will be delivered to customers.

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[24] SMRP 4.5, Low-Frequency Disturbances and Hum – Digital Modulation.

[25] Notice at ¶ 11.

[26] *Id*. at ¶ 9.

[27] *Id.*

Requiring operators to adhere to a vague requirement to provide a "good visual quality" signal as well as to comply with the objective SCTE 40 standards, therefore, would not only be unnecessary but also would be impractical. The subjective perception of "quality" with respect to audio and video content is affected by many factors, including the viewer's visual and aural acuity, viewing distance from the television set, and the quality of that set. It can also be impacted by the quality of the content that the operator receives at the headend that it simply passes through to customers.[28] A cable operator has no control over any of these factors.

To our knowledge, there is no industry-accepted method today for making this "subjective" measure "objective." Our review of existing technical resources has located no reliable and consistent way to take all these variables into account. While we understand that some work is commencing on objective assessments of HD video quality, no consensus has been reached. Any testing that has been developed to date is expensive and not amenable to unambiguous test results. Moreover, such testing has focused on comparing an impaired signal with an unimpaired reference copy, rather than directly assessing video quality of an impaired signal. Such an approach would not be practical at a subscriber's home.

Under these circumstances, the Commission should refrain from introducing the subjective concept of "good visual quality" into its "good technical quality" digital standards. Incorporating such a requirement into any proof-of-performance rules would impose unfair obligations on operators that they would have great difficulty proving they had met.

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[28] As the Notice recognizes, quality of programming can vary due to the source material. Technical problems at the signal source (i.e., cable program network or local broadcast station) or in the transportation link (e.g., satellite distribution) between the signal source and the cable headend can cause signal degradation. However, this type of degradation is generally outside an operator's control and troubleshooting often requires test equipment not generally available at the cable system level. That said, cable operators work closely with cable program networks to ensure that any problems associated with the incoming "visual" quality of the programming are quickly addressed.

C. Any Testing Should Not Require Measurements that Include Set-Top Boxes

The Notice also asks about "what role, if any, set-top boxes should play in the Commission's efforts to ensure consumers receive good quality signals" and whether it is "desirable to establish a testing regime which utilizes the output at the operator's leased set-top boxes as the testing point to determine whether a good quality signal is being delivered to subscribers?"[29] The Commission should not establish a testing regime that measures the output of a digital set-top box.

SCTE 40 defines the characteristics and normative specifications for digital network performance at the *input*, not the output, of the terminal equipment (i.e., set-top box). As SCTE 40 explains, "all specifications in this document apply at the Demarcation Point except as specifically noted."[30] The Demarcation Point is further defined to mean "as specified in FCC Rules 47 CFR Section 76.5(mm), which is typically a point at (or about) twelve inches outside of where the cable wire enters the subscriber's premises."[31] Attempting to extend the metrics established in SCTE 40 to encompass the effect of set-top boxes would thus conflict with its purpose.

Moreover, cable operators supply a variety of different digital set-top devices. These include digital transport adaptors (DTAs), standard definition and high definition set-top boxes, and DVRs. These devices include numerous output interface technologies, including analog NTSC RF channels, HDMI, component video, MoCA, and Ethernet, to name a few. No uniform method or procedure exists today that would enable operators to measure the effects of these

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[29] Notice at ¶ 24.

[30] SCTE 40 at 1.0.

[31] *Id*. at 2.2.

operator-supplied set-top boxes – let alone the devices that customers might own – on compliance with the SCTE standards.

In any event, the FCC already regulates set-top boxes under Part 15 of its rules.[32] As the Commission notes, these rules "ensure that boxes do not harm connected televisions or cause interference." [33]

For these reasons, set-top box performance should not be included as part of a cable system's technical standards. Instead, operators should be allowed to measure system performance in accordance with SCTE 40 at the end of a drop cable before the input of any terminal equipment.

D. The Commission Should Not Adopt Additional Design Parameters

The Notice also asks whether to supplement or otherwise modify the SCTE 40 standard and in particular points to the SCTE's Recommended Practice as a potential source of additional metrics.[34] While the SCTE Measurement Recommended Practice ("SMRP") provides a comprehensive and extensive set of testing methods for determining the operational performance of analog and digital signals on cable systems, it should not be made part of the rules.

The SMRP can be cited to as a general "how to" reference for tests and measurements to determine compliance with SCTE 40. However, further performance criteria beyond those defined in SCTE 40 are unnecessary to accurately determine the digital signal performance of a cable system. Furthermore, it would be inappropriate to utilize the SMRP as the basis for further performance criteria since it describes test methodology rather than performance parameters.

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[32] 47 C.F.R. § 15.115.

[33] Notice at ¶ 24 n. 64.

[34] *Id*. at ¶ 12.

III. THE COMMISSION SHOULD MINIMIZE ANY TESTING BURDENS AND RECORDKEEPING REQUIREMENTS IT IMPOSES

For the reasons explained above, the Commission should recognize that advancements in technology give operators the ability to proactively monitor their networks and respond more quickly than isolated proof-of-performance testing would ever provide. Operators should therefore have the flexibility to utilize existing tools and various existing performance metrics to gather test data and telemetry of plant health. These tools and methods would form a solid basis of an operator's performance. However, if the Commission should nonetheless require digital proof-of-performance testing, it should reduce burdensome testing and recordkeeping requirements to the extent possible. As explained below, the Notice proposes to reduce the number of channels required to be tested, but suggests a formula for determining the number of test points that could significantly and unnecessarily increase the burdens and costs of testing.

A. Number and Type of Channels Tested

The analog proof-of-performance rules for the most part require testing to occur on a sampling of channels based on a formula that differentiates between smaller and larger systems, and that increases based on overall channel capacity. The Notice proposes to "simplify" the formula in the case of analog and digital channels so that a system with total activated channel capacity up to 550 MHz would test 5 channels, and those with greater capacity would test 10 channels.[35] In addition, operators would be required to test each transmission format in proportion to its presence on the system, with at least two channels of both analog and digital to be tested.[36] To the extent the Commission requires testing, we agree with the effort to reduce the number of channels that must be tested to demonstrate compliance with the technical standards.

[35] Notice at ¶ 17.

[36] *Id*. at ¶ 18.

As the Notice recognizes, QAM channels can be used to deliver a variety of different video services.[37] From a technical standpoint, however, it does not matter if the QAM channel is being used for video on demand or linear video service. The "physical layer" transmission characteristics defined in SCTE 40 operate independently of the content carried on the QAM channel. Therefore, if testing is required, operators should be free to test whichever QAM channels they choose in order to demonstrate compliance.[38]

B. The Commission Should Not Increase the Number of Test Points

Current rules require analog proof-of-performance testing twice annually at specific points throughout the cable system. Systems with more subscribers must test at a correspondingly greater number of points, including at points of a technically-integrated system employing microwave distribution. The current analog rules also require certain test points to be located at the most distant part of the system.[39]

The Notice considers modifying the formula for determining the number of test points for digital signals. It asks whether "at least one test point, representative of the type of service (taking into account system architecture, channel delivery, and other technical characteristics) received by customers within that local franchise area, *be located within each LFA's jurisdiction*."[40] Since many integrated systems serve multiple franchise areas, imposing LFA-based testing obligations could significantly increase the number of test points beyond those currently required by the rules and should not be adopted.

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[37] *Id*. at ¶ 19.

[38] The Notice mentions cable modem service, noting that the Commission has excluded channels used for that purpose as well as for video on demand. *Id*. at ¶ 19. DOCSIS signals operate pursuant to separate standards not covered by SCTE 40 (*See* SCTE 40 at 6.3.5, noting that some but not all of the DOCSIS characteristics are similar to video signals covered by the SCTE standard) and in any event should not be covered by rules intended to cover the quality of QAM-based digital cable video service.

[39] 47 C.F.R. § 76.601(a)(1).

[40] Notice at ¶ 21(emphasis supplied).

As operators continue to consolidate headends, each system may serve many more individual franchise areas than before. An informal survey of NCTA members shows that a franchise-based testing requirement would significantly increase their testing burden. As just one example, an NCTA member reports serving more than 300 franchise areas from approximately 24 headends. At one test point per franchise area, its testing burden would increase by more than 200% from its current obligation. Another operator with five integrated cable systems serves more than 100 franchise areas; the proposal would lead to an increase of 166% over what is tested now. Yet another operator would face a 50% increase in testing obligations.

These potential new burdens come with increased costs. Operators would be required to devote significantly more time to proof-of-performance testing than today, taking system personnel away from other important system maintenance functions. If franchises are geographically distant from each other, the time spent on testing rather than other vital system functions would multiply as personnel, particularly in rural areas, would be forced to travel greater distances simply to conduct the tests. And the additional test points would necessitate the purchase of additional test equipment, particularly for those tests that require measuring performance over 24 hours.

The Notice provides no counterveiling benefits that would justify imposing these burdens and costs, which are unnecessary from a technical standpoint. The performance of today's integrated cable system does not vary based on franchise boundaries. For all these reasons, the burdens on operators that serve large numbers of franchises with a single integrated system should not be increased. Should the Commission nonetheless decide that individual franchise areas should be taken into account by requiring testing to be dispersed by franchise area, in no

event should operators be required to test at more points than would be required under the existing rules. The existing number of test points should be a ceiling, not a floor.

C. The Commission Should Minimize Any Proof-of-Performance Recordkeeping Burdens

Current rules require operators to maintain proof-of-performance test results at their local business office for at least five years[41] and provide them upon request to the Commission or local franchising authority.[42] The Notice expresses the view that "the current rule has been effective"[43] but fails to explain why. There is no evidence that proof-of-performance records are examined by any members of the public and even if they are, why they must be retained for so long.

In fact, most FCC rules require a much shorter retention period.[44] The expanded period for proof-of-performance record retention appears to be a vestige of earlier proposals that were adopted without any discussion.[45] It appears to have no relationship to the time period needed for local franchising authority review, and the results of tests conducted years earlier would have little if any relevance to any member of the public or LFA. Accordingly, the Commission should dispense with the five year recordkeeping requirement and simply provide, as it does under Section 76.1717, that cable operators be "prepared to show, on request by an authorized representative of the Commission or the local franchising authority, that the system does, in fact, comply with the technical standards rules in part 76, subpart K." Operators should be permitted

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[41] 47 C.F.R. § 76.1705.

[42] *Id.*, § 76.1717.

[43] Notice at ¶ 22.

[44] *See, e.g.*, 47 C.F.R. § 76.1701 (political file must be retained for two years); *id.*, § 76.1706 (signal leakage log and repair record must be retained for two years).

[45] *See* Cable Television Technical and Operational Requirements, Review of the Technical and Operational Requirements of part 76, 7 FCC Rcd 2021 at ¶ 23 (1992) (adopting the five year record retention policy without any discussion, merely noting that it had been proposed in the Notice in that proceeding).

to retain whatever records they believe in good faith demonstrate compliance. In addition, operators should retain their certification as described above for a period of no longer than a year in their public inspection file.

IV. THE RULES CAN PROTECT AGAINST DIGITAL SIGNAL LEAKAGE WITH REDUCED BURDENS ON OPERATORS

Protecting against interference with critical navigational and emergency frequencies remains an important goal, and generally we agree with many of the Notice's proposals regarding application of the signal leakage rules to digital signals. However, as described below, this protection can be accomplished in a manner less burdensome to the industry than the Notice proposes.

A. The Commission Should Retain its Notification Threshold

1. The FCC Should Not Change the Rules Triggering Analog AFNs

Cable operators must provide an "Aeronautical Frequency Notification ("AFN") prior to commencing operation in the aeronautical radio frequency bands above an average power level equal to or greater than 10^{-4} watts across a 25 kHz bandwidth in any 160 microsecond time period.[46] The Notice explains that "the vast majority of coaxial cable systems maintain an AFN on file with the Commission" and suggests therefore that its proposed change in power levels with respect to digital signal notification (proposing a digital threshold of 10^{-5} watts average power over a 30 kHz bandwidth in any 2.5 millisecond time period) "will only affect those systems that are operating a digital channel or channels in the aeronautical band between the existing analog threshold … and our proposed digital threshold."[47] However, the Notice proposes to change the AFN threshold in a manner that will affect not only digital signals but

[46] 47 C.F.R. § 76. 1804.

[47] *Id.* at ¶ 31.

also analog signals already operating in the aeronautical frequency band. In so doing, many operators that carry analog signals in the aeronautical bands will needlessly be forced to refile an AFN.

As the attached Technical Paper[48] prepared by David Large explains, "[m]any cable systems operate aural subcarriers of analog television channels at levels that fall between 10^{-4} watts and 10^{-5} watts, and so all such systems would have to file new form 321s identifying all such signals that fall into the protected frequency ranges, despite the lack of any evidence that the existing notification threshold for analog signals is inadequate, and also despite the fact that aural subcarriers present less interference potential than the visual carriers … and that they are already offset as a consequence of the visual carriers being offset."[49] In the absence of any identified problem with the existing rules that apply to analog signals, there is no reason to require operators to refile their AFNs to reflect changes in power levels that have no impact on safety. Accordingly, the Commission should retain its AFN rules for analog signals and avoid imposing unnecessary paperwork burdens.

2. AFNs For Digital Signals Should Not Be Triggered By an Unreasonably Low Threshold

Some refinements are also necessary to the proposals related to when AFNs must be filed for digital signals so that those requirements sync up with a showing of potential interference. While the Notice proposes to reduce the power threshold for digital signals in the aeronautical band by 1.2 dB,[50] it proposes to require AFN notification for operation in the band at a much

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[48] "Technical Comments on NPRM Regarding Testing of Digital Video Signals in Cable Systems, Including a Proposal For a Simplified Approach For Measuring Signal Leakage" by David Large ("Large Technical Paper") (Attachment B hereto).

[49] Large Technical Paper at 6.

[50] Notice at ¶ 30.

lower threshold – a 10 dB reduction.[51] The Notice provides no reason why AFNs should be filed at a threshold so much lower than the level at which the Commission's analysis demonstrates a potential problem. Under these circumstances, the two signal leakage rules should marry up so that the threshold for digital signal notifications should also be changed to 75.85 microwatts across a 25 kHz bandwidth in any 160 microsecond period[52] –the same power threshold the Commission proposes in Section 76. 610.

B. The Commission Can Accomplish its Goal of Protecting Aeronautical Safety without Requiring Operators to Obtain New Equipment

The Notice proposes several changes to account for digital signal carriage in the aeronautical band. As the Large Technical Paper describes, "the FCC has analyzed the potential for interference to aeronautical communications from digital signals and has concluded that, while the digital signal has a wider bandwidth (resulting in less of its power falling within the bandwidth of communications radios), such signals cannot be offset from communications channels, and so do not benefit from adjacent-channel rejection as do offset analog video signals."[53] Under these circumstances, the Commission's proposal to maintain the channel frequency offset requirements for analog signals but to eliminate the offset requirement for digital signals[54] is sound.

To protect against digital signal leakage, the Notice proposes (1) to create signal leakage limits for digital signals that are 1.2 dB lower than the existing analog limits; (2) to decrease the threshold at which signal leakage rules become applicable by 1.2 dB for digital signals carried in the aeronautical bands; and (3) to decrease the threshold of leaked digital signals strength that

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[51] *Id.*

[52] *See* Large Technical Paper at 6.

[53] Large Technical Paper at 2.

[54] Notice at ¶ 32.

must be included in the CLI calculation by 1.2 dB. The Large Technical Paper examines each of these proposed changes. Large concludes that the reduced signal leakage limit for digital signals is unobjectionable given the Notice's assumptions about communications receiver adjacent channel rejection and susceptible bandwidths. However, the Large Technical Paper explains that the Notice's proposed "changes to leakage monitoring and CLI calculations are unnecessarily complex and would result in added costs to operators without any benefit in controlling signal leakage amplitudes."[55]

These costs arise from requiring operators to invest in digital measurement equipment – equipment that for the most part is not yet deployed in any significant quantities. Cable operators today employ thousands of legacy leakage detection devices that use a proven technology for monitoring leakage in the 108-137 MHz aeronautical band. This equipment was not designed to be QAM digital-signal-compatible, and may not have the sensitivity to accurately measure the lower level signals.

However, as the Large Technical Paper explains, there is no reason to require operators to invest in additional equipment to detect digital signal leakage. It proposes an alternative method for accomplishing the same goal that does not require operators to incur this expense, using the existing test signal as a proxy. As Large details, the existing annual CLI procedure measures the effective shielding performance of the entire cable system's distribution plant by measuring leakage on a single dedicated test signal. Routine monitoring of this same test signal throughout the system (coupled with repair of any detected leaks) ensures that effective shielding is maintained. Limiting the amplitude of leaking analog television signals is assured by requiring the test signal to have an average power level equal to the average power level of the strongest

[55] Large Technical Paper at 3.

cable television carrier on the system. This formula can be adapted to measure digital signal leakage, as Large explains: "to ensure that whatever leaks occur are at least 1.2 dB lower in amplitude than would be the case for the maximum-allowable-strength analog signals in the same system, therefore, only requires that the levels at which they are carried on the cable plant be at least 1.2 dB lower than the test signal."[56]

Under this process, no additional change would be required to leakage monitoring or to CLI calculations since digital power levels would be required to be below the level of the leakage test signal. And cable operators could continue to use existing signal leakage detection equipment with the same sensitivity, measurement procedures, calculations and reporting.[57] Large explains that this method could be used for all-digital systems as well.[58] The Commission should permit operators to use the alternative method outlined in the Large Technical Paper for demonstrating compliance with the CLI requirements and leakage monitoring. It would enable operators to continue to use existing equipment without sacrificing safety protections.

While Large proposes an approach that can achieve the safety goals of the existing rules, the Commission should not mandate this or any other particular methodology. Rather, its rules should maintain flexibility so operators are not forced to use a dedicated test signal for leakage

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[56] Large Technical Paper at 5. As Large explains, such a reduced power requirement would have little impact on system operations. He states that "as required by ANSI/SCTE 40 2011, digital signals are normally suppressed by six to ten dB relative to analog television signals in systems that carry both, so my proposed alternate method will not require cable operators to change current operating practices and will result in leakage levels of digital signals that are comfortably below the FCC's new proposed requirements." *Id.*at 6 .

[57] The Notice suggests, in paragraph 34, the need for "analog and digital detectors to have sufficient sensitivity to detect the 1.2 dB decrease in the maximum signal leakage level… or 17.4 µV/m, in those systems which operate digital signals in the aeronautical band." However, as Large shows, this proposal is based on an apparent misunderstanding of the existing CLI and signal leakage requirements. Under those rules, regardless of whether an analog or digital signal is transmitted through a cable system, the only signal *measured* is the unmodulated test signal specified in Section 76.611(b). No digital detector is required for these measurements. Moreover, the simplified approach described above obviates the need for CLI and monitoring receivers to have higher sensitivity than existing equipment.

[58] Large Technical Paper at 6.

purposes if they choose to demonstrate compliance using a different methodology. As signal leakage monitoring and measurement testing technology and procedures develop, operators should be free to adapt their approach to demonstrating compliance so long as the test results can be correlated to the leakage threshold. Accordingly, the Commission should allow an operator that prefers to utilize an alternative test methodology to do so if that methodology yields equivalent results.[59]

C. The Rules Should Rely on Routine Monitoring and CLI Calculation to Protect Against Leakage, and Should Eliminate Requirements for Signal Leakage Measurements of Individual Analog or Digital Signals

The Notice asks how to apply the detailed measurement methodology for analog signal leakage contained in Section 76.609(h) to digital signal measurement techniques.[60] This methodology is relevant in that operators would be required to employ this measurement methodology prior to activating new plant.[61]

Cable operators routinely monitor the entirety of their systems for signal leakage. Operators equip their trucks and field staff with leakage detection devices and receive data daily on any leakage in the relevant bands – and are obligated to log and promptly correct any problems. The rules already provide that "the incorporation of this monitoring program into the daily activities of existing service personnel in the discharge of their normal duties will generally cover all portions of the system and will therefore meet this requirement."[62] There is no reason why this routine monitoring coupled with annual CLI calculation would be inadequate to protect against leakage – either for analog *or* for digital signals.

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[59] *See* 47 C.F.R. § 76.611 (permitting operator to use a modulated test signal so long as "the test signal and detector technique must, when considered together, yield the same result as though an unmodulated test signal were used in conjunction with a detection technique which would yield the RMS value of said unmodulated carrier.").

[60] Notice at ¶ 36.

[61] Proposed 47 C.F.R. § 76.611(e).

[62] 47 C.F.R. § 76.614.

In addition, as described in the Large Technical Paper, there are significant difficulties in measuring individual digital signals at this time. These challenges, as Large explains, relate to increased sensitivity due to lower signal leakage limits and the inherent difficulties in measuring wideband digital versus unmodulated or analog video signals. If operators were required to measure leaking digital signals at higher frequencies, "the problem is further magnified by the decrease in antenna efficiency as frequency increases… Since the level of thermal noise is constant with respect to frequency, the difficulties with making low-level measurements will increase proportionately."[63]

Under these circumstances, the Commission should deem the leakage testing and monitoring requirements of Sections 76.611 (CLI) and 76.614 (regular monitoring) sufficient to demonstrate compliance with the signal leakage rules.

D. The FCC Should Not Extend its Leakage Rules to Higher Frequency Bands as Part of This Rulemaking

Under the existing rules, signal leakage test frequencies are located within the 108-137 MHz band. The Notice raises the possibility that leakage from coaxial cable might occur to "critical infrastructure" operating above 400 MHz and asks about the implications of extending signal leakage protection to these higher bands.[64] The Notice references data from field tests conducted over the last year, indicating that higher frequency leakage does occur.[65]

While the issue of signal leakage may be common to both the midband and 700 MHz band, that does not translate into a uniform solution for both bands. In fact, there may be no correlation between aeronautical band leakage field strengths and leakage field strengths at these

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[63] Large Technical Paper at 8.

[64] Notice at ¶ 38.

[65] *Id.* at ¶ 38 n. 111. Operators also report instances of LTE devices in the home interfering with cable set-top boxes.

higher frequencies.[66] Therefore, it would be premature for the Commission to address leakage in the higher frequencies in the context of this rulemaking.

Additional study of this issue is needed before any across-the-board solution can be developed. To that end, the cable industry is examining this situation and its implications in SCTE Network Operations Subcommittee Working Group 1. The goal of the Working Group is to determine appropriate signal leakage limits for this band, and to recommend monitoring and measuring practices and procedures.[67]

V. THE FCC SHOULD UPDATE MISCELLANEOUS OTHER TECHNICAL RULES

Finally, the Notice proposes further edits to remove outdated and obsolete references, to incorporate current versions of standards, and other necessary editorial changes to Part 76 of the rules.[68] In addition to the edits that the Commission proposed, a few other changes are warranted.[69] To reduce confusion, we suggest deleting the phrase "formerly DVS …" in connection with all SCTE standards contained in Section 76.602(b). SCTE uses the "DVS" document nomenclature for internal purposes only and not for published standards.

In addition, Section 76.616 (operation near certain aeronautical and marine emergency radio frequencies) is ambiguous as written. Section 76.616(b) defines a measurement bandwidth for the power level of 10^{-5} watts in any 30 kHz bandwidth over any 2.5 millisecond interval.

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[66] *See* "Some Thoughts on LTE Interference," Ron Hranac, Communications Technology (Oct. 1, 2011).

[67] *See* "QAM Leakage and LTE Interference", http://www.scte.org/documents/pdf/interval/Interval%203Q2012REVISED.pdf at 7 (noting Working Group 1's intent to "investigate the concern of QAM leakage in the 700 MHz band. …Working Group 1 plans to outline recommended test procedures for service providers to help locate leaky equipment and how to avoid interference with LTE.").

[68] *Id*. at ¶ 40.

[69] *See* Attachment A.

However, § 76.616(a) does not specify a measurement bandwidth. The Commission should clarify the measurement bandwidth requirements of the subsection.

CONCLUSION

For the foregoing reasons, the Commission should adopt digital technical standards and signal leakage rules that do not impose unnecessary burdens and costs on cable operators.

Respectfully submitted,

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ATTACHMENT A

Attachment A*

Following is a red-line version of the FCC's proposed rules containing the changes suggested by NCTA.

Proposed Rules

Part 76 of the Commission's rules are to be revised as follows:

PART 76 – Multichannel Video and Cable Television Service:

1. The Authority Citation for Part 76 continues to read as follows:

AUTHORITY: 47 U.S.C. 151, 152, 153, 154, 301, 302, 302a, 303, 303a, 307, 308, 309, 312, 315, 317, 325, 339, 340, 341, 503, 521, 522, 531, 532, 534, 535, 536, 537, 543, 544, 544a, 545, 548, 549, 552, 554, 556, 558, 560, 561, 571, 572, 573.

2. Revise § 76.601(b) to read as follows

§ 76.601 Performance tests.

(a) * * *

(b) The operator of each cable television system shall conduct complete performance tests of that system at least twice each calendar year (at intervals not to exceed seven months), unless otherwise noted below. The performance tests shall be directed at determining the extent to which the system complies with all the technical standards set forth in § 76.605~~(a)~~ and shall be as follows:

(1) For cable television systems with 1000 or more subscribers but with 12,500 or fewer subscribers, proof-of-performance tests conducted pursuant to this section shall include measurements taken at six (6) widely separated points. However, within each cable system, one additional test point shall be added for every additional 12,500 subscribers or fraction thereof (e.g., 7 test points if 12,501 to 25,000 subscribers; 8 test points if 25,001 to 37,500 subscribers, etc.). In addition, for technically integrated portions of cable systems that are not mechanically continuous (~~i.e.~~ **e.g.**, employing microwave connections), at least one test point will be required for each portion of the cable system served by a technically integrated ~~microwave~~ hub. The proof-of-performance test points chosen shall be balanced to represent all geographic areas served by the cable system~~ and should include at least one test point in each local franchise area~~**.** At least one-third of the test points shall be representative of subscriber terminals most distant from the system input and from each microwave receiver (if microwave transmissions are employed), in terms of cable length. The measurements may be taken at convenient monitoring points in the cable network: ~~P~~**p**rovided, that data shall be included to relate the measured performance of the system as would be viewed from a nearby subscriber terminal. An

* NCTA edits reflecting discussion in its Comments noted in red.

identification of the instruments, including the makes, model numbers, and the most recent date of calibration, a description of the procedures utilized, and a statement of the qualifications of the person performing the tests shall also be included.

(2) Proof-of-performance tests to determine the extent to which a cable television system complies with the standards set forth in § 76.605~~(a)~~**(b)** (3), (4), and (5) shall be made on each of the NTSC or similar video channels of that system. Unless otherwise ~~as~~ noted, proof-of-performance tests for all other standards in § 76.605~~(a)~~**(b)** shall be made on a minimum of ~~four (4) channels plus one additional channel for every 100 MHz, or fraction thereof, of cable distribution system upper frequency limit (e.g., 5 channels for cable television systems with a cable distribution system upper frequency limit of 101 to 216 MHz; 6 channels for cable television systems with a cable distribution system upper frequency limit of 217–300 MHz; 7 channels for cable television systems with a cable distribution upper frequency limit to 300 to 400 MHz, etc.)~~ **five (5) channels for systems operating a total activated channel capacity of less than 550 MHz, and ten (10) channels for systems operating a total activated channel capacity of 550 MHz or greater.** The channels selected for testing must be representative of all the channels within the cable television system.

(i) The operator of each cable television system shall conduct semi-annual proof-of-performance tests of that system, to determine the extent to which the system complies with the technical standards set forth in § 76.605~~(a)~~**(b)**(4) as follows. The visual signal level on each channel shall be measured and recorded, along with the date and time of the measurement, once every six hours (at intervals of not less than five hours or no more than seven hours after the previous measurement), to include the warmest and the coldest times, during a 24-hour period in January or February and in July or August.

(ii) The operator of each cable television system shall conduct triennial proof-of-performance tests of its system to determine the extent to which the system complies with the technical standards set forth in § 76.605~~(a)~~**(b)**(11).

(3) Proof-of-performance tests to determine the extent to which a cable television system complies with the standards set forth in § 76.605(c)(~~1~~2) shall be made on each of the QAM ~~or similar~~ video channels of that system. Unless otherwise as noted, proof-of-performance tests for all other standards in § 76.605(c) shall be made on a minimum of five (5) channels for systems operating a total activated channel capacity of less than 550 MHz, and ten (10) channels for systems operating a total activated channel capacity of 550 MHz or greater. The channels selected for testing must be representative of all the channels within the cable television system.

(4) For cable television~~s~~ systems which operate both NTSC or similar and QAM ~~of similar~~ channels, proof-of-performance tests to determine the extent to which the cable television~~s~~ system complies with § 76.605(b)(1), (2), (6)-(11) and 76.605(c)(1) shall be apportioned relative to the proportion of channels allocated to each transmission type, except that at no time shall less than two channels of a particular type be tested.

(c) * * *

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3. Revise § 76.602(b)(7) to read as follows:

§ 76.602 Incorporation by Reference.

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(b) **ATSC.** * * *

(1) ATSC A/65~~B~~**D**: "ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable (Revision ~~B~~**D**)," ~~March 18, 2003~~**April 14, 2009**, IBR approved for §76.640.

(2) ATSC A/85:2011 "ATSC Recommended Practice: Techniques for Establishing and Maintaining Audio Loudness for Digital Television," (July 25, 2011) ("ATSC A/85 RP"), IBR approved for §76.607.

(c) **CEA.** * * *

(1) CEA–542–~~B~~**C**, "CEA Standard: Cable Television Channel Identification Plan," July ~~2003~~**2009**, IBR approved for §76.605.

(2) CEA–931–~~A~~**C**, "Remote Control Command Pass-through Standard for Home Networking," ~~2003~~**2007**, IBR approved for §76.640.

(d) **SCTE.** * * *

(1) ANSI/SCTE 26 ~~2001~~**2010** (formerly DVS 194): "Home Digital Network Interface Specification with Copy Protection," ~~2001~~**2010**, IBR approved for §76.640.

(~~2~~1) **ANSI/**SCTE 28 ~~2003~~**2012** ~~(formerly DVS 295)~~: "Host-POD Interface Standard," ~~2003~~**2012**, IBR approved for §76.640.

(~~3~~2) **ANSI/**SCTE 40 ~~2003~~**2011** ~~(formerly DVS 313)~~, "Digital Cable Network Interface Standard," ~~2003~~**2011**, IBR approved for §**§ 76.605 and** 76.640.

(~~4~~3) **ANSI/**SCTE 41 ~~2003~~**2011** ~~(formerly DVS 301)~~: "POD Copy Protection System," ~~2003~~**2011**, IBR approved for §76.640.

(~~5~~4) ANSI/SCTE 54 ~~2003~~**2009** ~~(formerly DVS 241)~~, "Digital Video Service Multiplex and Transport System Standard for Cable Television," ~~2003~~**2009**, IBR approved for §76.640.

(~~6~~5) ANSI/SCTE 65 ~~2002~~**2008** ~~(formerly DVS 234)~~, "Service Information Delivered Out-of-Band for Digital Cable Television," ~~2002~~**2008**, IBR approved for §76.640.

(e) * * *

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4. Revise § 76.605 to read as follows

§ 76.605 Technical standards.

(a) The following requirements apply to the performance of a cable television system as measured at the input to any ~~subscriber~~ terminal device with a matched impedance at the termination point or at the output of the modulating or processing equipment (generally the headend) of the cable television system or otherwise noted herein or in ANSI/SCTE 40 2011. **The requirements of subsection (b) of this section are applicable to each NTSC or similar video downstream cable television channel in the system, the requirements of subsection (c) are applicable to each QAM ~~or similar~~ video downstream cable television channel in the system, and the requirements of subsection (d) are applicable to all downstream cable television channels in the system. Cable television systems utilizing other technologies to distribute programming must comply with subsection (e).**

(b) For each NTSC or similar video downstream cable television channel in the system:

(1)(i) The cable television channels delivered to the subscriber's terminal shall be capable of being received and displayed by TV broadcast receivers used for off-the-air reception of TV broadcast signals, as authorized under part 73 of this chapter; and

(ii) Cable television systems shall transmit signals to subscriber premises equipment on frequencies in accordance with the channel allocation plan set forth in ~~CEA-542-B~~**CEA-542-C**: "Standard: Cable Television Channel Identification Plan," (Incorporated by reference, see § 76.602).

(2) The aural center frequency of the aural carrier must be 4.5 MHz ±5 kHz above the frequency of the visual carrier at the output of the modulating or processing equipment of a cable television system, and at the subscriber terminal.

(3) The visual signal level, across a terminating impedance which correctly matches the internal impedance of the cable system as viewed from the subscriber terminal, shall not be less than 1 millivolt across an internal impedance of 75 ohms (0 dBmV). Additionally, as measured at the end of a 30 meter (100 foot) cable drop that is connected to the subscriber tap, it shall not be less than 1.41 millivolts across an internal impedance of 75 ohms (+3 dBmV). (At other impedance values, the minimum visual signal level, as viewed from the subscriber terminal, shall be the square root of 0.0133 (Z) millivolts and, as measured at the end of a 30 meter (100 foot) cable drop that is connected to the subscriber tap, shall be 2 times the square root of 0.00662(Z) millivolts, where Z is the appropriate impedance value.)

(4) The visual signal level on each channel, as measured at the end of a 30 meter cable drop that is connected to the subscriber tap, shall not vary more than 8 decibels within any six-month interval, which must include four tests performed in six-hour increments during a 24-hour period

in July or August and during a 24-hour period in January or February, and shall be maintained within:

(i) 3 decibels (dB) of the visual signal level of any visual carrier within a 6 MHz nominal frequency separation;

(ii) 10 dB of the visual signal level on any other channel on a cable television system of up to 300 MHz of cable distribution system upper frequency limit, with a 1 dB increase for each additional 100 MHz of cable distribution system upper frequency limit (e.g., 11 dB for a system at 301-400 MHz; 12 dB for a system at 401-500 MHz, etc.); and

(iii) A maximum level such that signal degradation due to overload in the subscriber's receiver or terminal does not occur.

(5) The rms voltage of the aural signal shall be maintained between 10 and 17 decibels below the associated visual signal level. This requirement must be met both at the subscriber terminal and at the output of the modulating and processing equipment (generally the headend). For subscriber terminals that use equipment which modulate and remodulate the signal (e.g., baseband converters), the rms voltage of the aural signal shall be maintained between 6.5 and 17 decibels below the associated visual signal level at the subscriber terminal.

(6) The amplitude characteristic shall be within a range of ±2 decibels from 0.75 MHz to 5.0 MHz above the lower boundary frequency of the cable television channel, referenced to the average of the highest and lowest amplitudes within these frequency boundaries. The amplitude characteristic shall be measured at the subscriber terminal.

(7) The ratio of RF visual signal level to system noise shall not be less than 43 decibels. For class I cable television channels, the requirements of this section are applicable only to:

(i) Each signal which is delivered by a cable television system to subscribers within the predicted Grade B **or noise-limited service** contour**, as appropriate,** for that signal;

(ii) Each signal which is first picked up within its predicted Grade B **or noise-limited service** contour**, as appropriate**;

(iii) Each signal that is first received by the cable television system by direct video feed from a TV broadcast station, a low power TV station, or a TV translator station.

(8) The ratio of visual signal level to the rms amplitude of any coherent disturbances such as intermodulation products, second and third order distortions or discrete-frequency interfering signals not operating on proper offset assignments shall be as follows:

(i) The ratio of visual signal level to coherent disturbances shall not be less than 51 decibels for noncoherent channel cable television systems, when measured with modulated carriers and time averaged; and

(ii) The ratio of visual signal level to coherent disturbances which are frequency-coincident with the visual carrier shall not be less than 47 decibels for coherent channel cable systems, when measured with modulated carriers and time averaged.

(9) The terminal isolation provided to each subscriber terminal:

(i) Shall not be less than 18 decibels. In lieu of periodic testing, the cable operator may use specifications provided by the manufacturer for the terminal isolation equipment to meet this standard; and

(ii) Shall be sufficient to prevent reflections caused by open-circuited or short-circuited subscriber terminals from producing visible picture impairments at any other subscriber terminal.

(10) The peak-to-peak variation in visual signal level caused by undesired low frequency disturbances (hum or repetitive transients) generated within the system, or by inadequate low frequency response, shall not exceed 3 percent of the visual signal level. Measurements made on a single channel using a single unmodulated carrier may be used to demonstrate compliance with this parameter at each test location.

(11) The following requirements apply to the performance of the cable television system as measured at the output of the modulating or processing equipment (generally the headend) of the system:

(i) The chrominance-luminance delay inequality (or chroma delay), which is the change in delay time of the chrominance component of the signal relative to the luminance component, shall be within 170 nanoseconds.

(ii) The differential gain for the color subcarrier of the television signal, which is measured as the difference in amplitude between the largest and smallest segments of the chrominance signal (divided by the largest and expressed in percent), shall not exceed ±20%.

(iii) The differential phase for the color subcarrier of the television signal which is measured as the largest phase difference in degrees between each segment of the chrominance signal and reference segment (the segment at the blanking level of 0 IRE), shall not exceed ±10 degrees.

(c) For each downstream QAM ~~or similar~~ video downstream cable television channel in the system the technical requirements of ANSI/SCTE 40 2011 ~~(Formerly DVS 313)~~: "Digital Cable Network Interface Standard" (incorporated by reference, *see* § 76.602) shall apply, provided:

(1) For purposes of demonstrating compliance with proof-of-performance, the RF transmission characteristics of Table 4, lines 1-2, 4, 8-9, and 11-13, shall be tested and recorded pursuant to §§ 76.601 and 76.1706, except that~~.~~:

(i) Compliance with lines 1 and 2 may be demonstrated by operator certification.

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(ii) Proof-of-performance tests to determine the extent to which a cable system complies with lines 4 and 12 shall be made on 64-QAM and 256-QAM video signal types only.

(iii) Proof-of-performance tests to determine the extent to which a cable system complies with line 8 may be made on a single channel using the nearest analog signal, or may be made on a single channel using a single unmodulated carrier.

(iv) In lieu of proof-of-performance tests, cable operators whose systems do not include any RF frequency changing equipment between the last point of modulation and the input to terminal equipment may demonstrate compliance with line 11 by providing manufacturers' specifications for the equipment used for modulation.

(2) For purposes of demonstrating compliance with proof-of-performance, the criteria of Table 4, line 14 that apply to QAM video signals, the Nominal Relative Carrier Power Levels of Table 5, and the Adjacent Channel Characteristics of Table 6, lines 1-9 and 14-15 ~~and the Nominal Relative Carrier Power Levels of Table 5~~ shall be tested and recorded pursuant to §§ 76.601 and 76.1706, except that tests to determine the extent to which a cable system complies with Table 5 shall be performed at output of the modulating or processing equipment (generally the headend) of the system.

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(d) As an exception to the general provision requiring measurements to be made at subscriber terminals, and without regard to the type of signals carried by the cable television system, signal leakage shall be limited as follows:

Frequencies	Signal leakage limit	Distance in meters (m)
Analog signals less than and including 54 MHz, and over 216 MHz	15 µV/m	30
Digital signals less than and including 54 MHz, and over 216 MHz	**13.1 µV/m**	**30**
Analog signals over 54 MHz up to and including 216 MHz	20 µV/m	3
Digital signals over 54 MHz up to and including 216 MHz	**17.4 µV/m**	**3**

Where analog NTSC or similar signals are measured in accordance with the procedures outlined in § 76.609(h).

(e) Cable television systems distributing signals by ~~using~~ methods ~~such as nonconventional coaxial cable techniques, noncoaxial copper cable techniques, specialized coaxial cable and fiber optical cable hybridization techniques or specialized compression techniques or specialized receiving devices~~,**other than 6 MHz NTSC or similar analog channels or 6 MHz QAM or similar channels on conventional coaxial or hybrid fiber-coaxial cable systems and** which, because of their basic design, cannot comply with one or more of the technical standards set forth in paragraph**s** ~~(a)~~ **(b) and (c)** of this section, may be permitted to operate~~: provided, That an~~

~~adequate showing is made pursuant to §76.7 which establishes that the public interest is benefited. In such instances, the Commission may prescribe special technical requirements to ensure that subscribers to such systems are provided with an equivalent level of good quality service~~ **upon Commission approval on a case-by-case basis. To obtain Commission approval, the operator must submit to the Commission its own proof-of-performance plan for ensuring subscribers receive good quality signals.**

Note 1: Local franchising authorities of systems serving fewer than 1000 subscribers may adopt standards less stringent than those in § 76.605(b) and (c). Any such agreement shall be reduced to writing and be associated with the system's proof-of-performance records.

Note 2: For systems serving rural areas as defined in § 76.5, the system may negotiate with its local franchising authority for standards less stringent than those in §§ 76.605~~(a)~~**(b)**(3), 76.605~~(a)~~**(b)**(7), 76.605~~(a)~~**(b)**(8), 76.605~~(a)~~**(b)**(10) and 76.605~~(a)~~**(b)**(11). Any such agreement shall be reduced to writing and be associated with the system's proof-of-performance records.

Note 3: The requirements of this section shall not apply to devices subject to the TV interface device rules under part 15 of this chapter.

~~Note 4: Should subscriber complaints arise from a system failing to meet §76.605(a)(6) prior to December 30, 1999, the cable operator will be required to provide a converter that will allow the system to meet the standard immediately at the complaining subscriber's terminal. Further, should the problem be found to be system-wide, the Commission may order all converters on the system be changed to meet the standard.~~

Note ~~5~~**4**: Should subscriber complaints arise from a system failing to meet § 76.605~~(a)~~**(b)**(10), the cable operator will be required to remedy the complaint and perform test measurements on § 76.605~~(a)~~**(b)**(10) containing the full number of channels as indicated in § 76.601(b)(2) at the complaining subscriber's terminal. Further, should the problem be found to be system-wide, the Commission may order that the full number of channels as indicated in § 76.601(b)(2) be tested at all required locations for future proof-of-performance tests.

Note ~~6~~**5**: No State or franchising authority may prohibit, condition, or restrict a cable system's use of any type of subscriber equipment or any transmission technology.

5. Revise § 76.610 to read as follows:

§ 76.610 Operation in the frequency bands 108–137 MHz and 225–400 MHz – scope of application.

The provisions of §§~~76.605(a)(12)~~**76.605(d)**, 76.611, 76.612, 76.613, 76.614, 76.616, 76.617, 76.1803 and 76.1804 are applicable to all MVPDs (cable and non-cable) transmitting **analog** carriers or other signal components carried at an average power level equal to or greater than 10^{-4} watts across a 25 kHz bandwidth in any 160 microsecond period **or transmitting digital carriers or other signal components at an average power level of 75.85 microwatts across a 25 kHz bandwidth in any 160 microsecond period** at any point in the cable distribution system

in the frequency bands 108–137 and 225–400 MHz for any purpose. Exception: Non-cable MVPDs serving less than 1000 subscribers and less than 1000 units do not have to comply with § 76.1803.

6. Revise § 76.611 to read as follows:

§ 76.611 Cable television basic signal leakage performance criteria.

(a) No cable television system shall commence or provide service in the frequency bands 108-137 and 225-400 MHz unless such systems is in compliance with one of the following cable television basic signal leakage performance criteria:

(1) prior to carriage of signals in the aeronautical radio bands and at least once each calendar year, with no more than 12 months between successive tests thereafter, based on a sampling of at least 75% of the cable strand, and including any portion of the cable system which are known to have or can reasonably be expected to have less leakage integrity than the average of the system, the cable operator demonstrates compliance with a cumulative signal leakage index by showing either that (i) 10 log I_{3000} is equal to or less than −7 ~~for **analog** systems and **equal to or less than −8.2 for digital systems**~~ or (ii) 10 log I_{∞} is equal to or less than 64 ~~for **analog** systems and **equal to or less than 62.8 for digital systems**~~, using one of the following formula, **except that no system of diameter greater than 160 kilometers may utilize I_{3000}**:

$$I_{3000} = \frac{1}{\theta}\sum_{i=1}^{n}\frac{E_i^2}{R_i^2},$$

$$I_{\infty} = \frac{1}{\theta}\sum_{i=1}^{n}E_i^2,$$

where:

$$R_i^2 = r_i^2 + (3000)^2$$

r_i is the distance (in meters) between the leakage source and the center of the cable television system;

θ is the fraction of the system cable length actually examined for leakage sources and is equal to the strand kilometers (strand miles) of plant tested divided by the total strand kilometers (strand miles) in the plant;

R_i is the slant height distance (in meters) from leakage source i to a point 3000 meters above the center of the cable television system;

E_i is the electric field strength in microvolts per meter (μV/m) measured 3 meters from the leak i; and

n is the number of leaks found of field strength equal to or greater than 50 μV/m ~~for **analog** leaks~~ measured pursuant to §76.609(h) ~~**or 43.6 μV/m for digital leaks**~~.

The sum is carried over all leaks i detected in the cable examined; or

(2) prior to carriage of signals in the aeronautical radio bands and at least once each calendar year, with no more than 12 months between successive tests thereafter, the cable operator demonstrates by measurement in the airspace that at no point does the field strength generated by the cable system exceed 10 microvolts per meter (µV/m) RMS ~~for **an offset analog signal or 8.7 microvolts per meter (µV/m) RMS for a digital signal**~~ at an altitude of 450 meters above the average terrain of the cable system. The measurement system (including the receiving antenna) shall be calibrated against a known field of 10 µV/m RMS produced by a well characterized antenna consisting of orthogonal resonant dipoles, both parallel to and one quarter wavelength above the ground plane of a diameter of two meters or more at ground level. The dipoles shall have centers collocated and be excited 90 degrees apart. The half-power bandwidth of the detector shall be 25 kHz. If an aeronautical receiver is used for this purpose it shall meet the standards of the Radio Technical Commission for Aeronautics (RCTA) for aeronautical communications receivers. The aircraft antenna shall be horizontally polarized. Calibration shall be made in the community unit or, if more than one, in any of the community units of the physical system within a reasonable time period to performing the measurements. If data is recorded digitally the 90th percentile level of points recorded over the cable system shall not exceed ~~**8.7 µV/m or**~~ 10 µV/m RMS as indicated above; if analog recordings is used the peak values of the curves, when smoothed according to good engineering practices, shall not exceed ~~**8.7 µV/m or**~~ 10 µV/m RMS ~~**for digital or analog leakage, respectively**~~.

(b) In paragraphs (a)(1) and (a)(2) of this section the unmodulated test signal used for analog leakage measurements on the cable plant shall: (1) ~~B~~be within the VHF aeronautical band 108-137 MHz or any other frequency ~~in~~for which the results can be correlated to the VHF aeronautical band and (2) have an average power level equal to the greater of (a) the ~~average~~ peak envelope power level of the strongest NTSC or similar analog cable television ~~carrier~~ signal on the system, or (b) 1.2 dB greater than the average power level of the strongest QAM or similar digital cable television signal on the system.

(c) In paragraph (a)(1) and (2) of this section, if a modulated test signal is used for analog leakage measurements, the test signal and detector technique must, when considered together, yield the same result as though an unmodulated test signal were used in conjunction with a detection technique which would yield the RMS value of said unmodulated carrier.

(d) If a sampling of at least 75% of the cable strand (and including any portions of the cable system which are known to have or can reasonably be expected to have less leakage integrity than the average of the system) as described in paragraph (a)(1) cannot be obtained by the cable operator or is otherwise not reasonably feasible, the cable operator shall perform the airspace measurements described in paragraph (a)(2).

(e) Prior to providing service to any subscriber on a new section of cable plant, the operator shall show compliance with either: (1) The basic signal leakage criteria in accordance with paragraph (a)(1) or (a)(2) of this section for the entire plant in operation or (2) a showing shall be made indicating that no individual leak in the new section of the plant exceeds 20 µV/m at 3 meters in

accordance with § 76.609 ~~fo~~ **of** the Rules for **analog ~~systems~~ signals or 17.4 µV/m at 3 meters for digital ~~systems~~signals**.

(f) Notwithstanding paragraph (a) of this section, a cable operator shall be permitted to operate on any frequency which is offset pursuant to §76.612 in the frequency band 108–137 MHz for the purpose of demonstrating compliance with the cable television basic signal leakage performance criteria.

7. Revise § 76.612 to read as follows:

§ 76.612 Cable television frequency separation standards.

All cable television systems which operate **analog NTSC or similar channels** in the frequency bands 108-137 MHZ and 225-400 MHz shall comply with the following frequency separation standards **for each NTSC or similar channel:**

(a) * * *

* * * * *

8. Revise § 76.614 to read as follows:

§ 76.614 Cable television regular monitoring.

Cable television operators transmitting carriers in the frequency bands 108-137 and 225-400 MHz shall provide for a program of regular monitoring for signal leakage by substantially covering the plant every three months. The incorporation of this monitoring program into the daily activities of existing service personnel in the discharge of their normal duties will generally cover all portions of the system and will therefore meet this requirement. Monitoring equipment and procedures utilized by a cable operator shall be adequate to detect a leakage source ~~**from an analog signal**~~ which produces a field strength in these bands of 20 µV/m or greater at a distance of 3 meters ~~**and from a digital signal which produces a field strength in these bands of 17.4 µV/m or greater at a distance of 3 meters**~~. During regular monitoring, any ~~**analog leakage**~~ source which produces a field strength of 20 µV/m or greater at a distance of 3 meters ~~**or digital leakage source which produces a field strength of 17.4 µV/m or greater at a distance of 3 meters**~~ in the aeronautical radio frequency bands shall be noted and such leakage sources shall be repaired within a reasonable period of time.

Note 1 to § 76.614: Section 76.1706 contains signal leakage recordkeeping requirements applicable to cable operators.

9. Revise § 76.640(b)(1)(i) to read as follows:

§ 76.640 Support for unidirectional digital cable products on digital cable systems.

(a) * * *

(b) ~~No later than July 1, 2004,~~ Cable operators shall support unidirectional digital cable products, as defined in §15.123 of this chapter, through the provisioning of Point of Deployment modules (PODs) and services, as follows:

(1) Digital cable systems with an activated channel capacity of 750 MHz or greater shall comply with the following technical standards and requirements:

(i) **ANSI**/SCTE 40 ~~2003~~**2011** ~~(formerly DVS 313)~~: "Digital Cable Network Interface Standard" (incorporated by reference, see §76.602), ~~provided however that with respect to Table B.11, the Phase Noise requirement shall be −86 dB/Hz, and also~~ provided that the "transit delay for most distant customer" requirement in Table ~~B.3~~ **4.3** is not mandatory.

(ii) **ANSI/**SCTE 65 ~~2002~~**2008** ~~(formerly DVS 234)~~: "Service Information Delivered Out-of-Band for Digital Cable Television" (incorporated by reference, see §76.602), provided however that the referenced Source Name Subtable shall be provided for Profiles 1, 2, and 3.

(iii) **ANSI/**SCTE 54 ~~2003~~**2009** ~~(formerly DVS 241)~~: "Digital Video Service Multiplex and Transport System Standard for Cable Television" (incorporated by reference, see §76.602).

(iv) For each digital transport stream that includes one or more services carried in-the-clear, such transport stream shall include virtual channel data in-band in the form of ATSC A/65~~B~~**D**: "ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable (Revision ~~B~~**D**)" (incorporated by reference, see §76.602), when available from the content provider. With respect to in-band transport:

(A) * * *

(B) * * *

(C) The format of event information data format shall conform to ATSC A/65~~B~~**D**: "ATSC Standard: Program and System Information Protocol for Terrestrial Broadcast and Cable (Revision ~~B~~**D**)" (incorporated by reference, see §76.602);

(D) * * *

(E) * * *

(v) When service information tables are transmitted out-of-band for scrambled services:

(A) The data shall, at minimum, describe services carried within the transport stream carrying the PSIP data itself;

(B) A virtual channel table shall be provided via the extended channel interface from the POD module. Tables to be included shall conform to **ANSI/**SCTE 65 ~~2002~~**2008** ~~(formerly DVS 234)~~: "Service Information Delivered Out-of-Band for Digital Cable Television" (incorporated by reference, see §76.602).

(C) Event information data when present shall conform to **ANSI/SCTE 65 2008** ~~(formerly DVS 234)~~: "Service Information Delivered Out-of-Band for Digital Cable Television" (incorporated by reference, see §76.602) (profiles 4 or higher).

(D) * * *

(E) * * *

(2) All digital cable systems shall comply with:

(i) **ANSI**/SCTE 28 ~~2003~~**2012** ~~(formerly DVS 295)~~: "Host-POD Interface Standard" (incorporated by reference, see §76.602).

(ii) SCTE 41 ~~2003~~**2011** ~~(formerly DVS 301)~~: "POD Copy Protection System" (incorporated by reference, see §76.602).

(3) * * *

* * * * *

10. Amend § 76.1804 to read as follows:

§ 76.1804 Aeronautical Frequencies Notification

An MVPD shall notify the Commission before transmitting any digital signal with average power exceeding 75.85 microwatts across a 25 kHz bandwidth in 160 microsecond time period or, for other signal types, any carrier of other signal component with an average power level across a ~~25 kHz bandwidth in any 160 microsecond time period equal to or greater than 10^{-4} watts~~ 25 kHz bandwidth in any 160 microsecond time period equal to or greater than 10^{-4} watts ~~**30 kHz bandwidth in any 2.5 millisecond time period equal to or greater than 10^{-5} watts**~~ at any point in the cable distribution system on any new frequency or frequencies in the aeronautical radio frequency bands (108-137 MHz, 225-400 MHz). The notification shall be made on FCC Form 321. Such notification shall include:

(a) * * *

* * * * *

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ATTACHMENT B

Attachment B

TECHNICAL COMMENTS ON NPRM REGARDING TESTING OF DIGITAL VIDEO SIGNALS IN CABLE SYSTEMS, INCLUDING A PROPOSAL FOR A SIMPLIFIED APPROACH FOR MEASURING SIGNAL LEAKAGE

David Large[1], President
David Large, Consultants

INTRODUCTION

The Federal Communications Commission ("FCC"), in its August 3, 2012 Notice of Proposed Rulemaking[2], has proposed setting limits on signal leakage from digital signals and changes in how cumulative signal leakage ("CLI") is calculated to reflect those limits. The changes in methodology proposed in the NPRM would require changes in signal leakage measurements and CLI calculations and, potentially, new and more expensive test equipment.

I am proposing herein an alternate approach that is simpler for both regulators and operators, yet is equally effective in accomplishing the goals set forth in the NPRM. It allows continued use of existing test equipment, reporting forms, and calculations. Furthermore, it equally accommodates analog, hybrid, and all-digital cable systems.

The FCC has also asked a number of related technical questions to which I wish to respond.

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[1] David Large has 39 years of experience in the design of cable television equipment, cable television operations, and consulting to governments, operators, vendors, industry associations, and legal firms on broadband technology issues. He has participated in numerous inter-industry and rulemaking activities, including the NCTA/EIA Joint Engineering Committee, the FCC's Network Reliability Council, the SCTE's Interface Practices and Digital Video standards-making subcommittees and filings in FCC technical rulemakings and inquiries. David is a co-author of both *Modern Cable Television Technology* and *Broadband Cable Access Networks*, standard industry reference texts, and was a contributor to multiple editions of the *NCTA Recommended Practices for Measurements on Cable Television Systems* (the predecessor document to the *SCTE Measurement Recommended Practices for Cable Systems*). He is a graduate of the California Institute of Technology, a Fellow of the Society of Cable Telecommunications Engineers (SCTE), a Senior member of the IEEE, and holds patents in microwave and cable television measurement technology.

[2] FCC MB Docket No. 12-217, adopted August 3, 2012.

PART I: A PROPOSAL FOR A SIMPLIFIED APPROACH FOR MEASURING SIGNAL LEAKAGE FROM ANALOG, DIGITAL AND HYBRID ANALOG/DIGITAL CABLE SYSTEMS

EXISTING OPERATOR PRACTICE

Cable operators accomplish the CLI calculation requirements of §76.611 and the regular leakage monitoring requirements of §76.614 by using a single test signal that may be an unmodulated carrier, the visual carrier of an analog television signal, or a special test signal. That signal's frequency is within or near the 108-137 MHz aeronautical band and has an amplitude that is at least equal to the average level of the strongest analog television signal carried over the system, as specified in §76.611(b) and (c). In order to measure the low-level leaking test signals accurately, the test equipment typically uses a narrow bandwidth to reduce potential errors from other over-air sources and to reduce the amount of thermal noise reaching the detector.

This method measures, and assures maintenance of, the overall shielding effectiveness of the cable system near the aeronautical band (expressed as the cumulative leakage index ("CLI") value), while the requirement that the test signal be at least as high in amplitude as the highest-amplitude analog video signal ensures that no other leaking signal carried over the system should exceed the leakage measured using the test signal.

THE NEW METHODOLOGY PROPOSED BY THE FCC

The FCC has analyzed the potential for interference to aeronautical communications from digital signals[3] and has concluded that, while the digital signal has a wider bandwidth (resulting in less of its power falling within the bandwidth of communications radios), such signals cannot be offset from communications channels, and so do not benefit from adjacent-channel rejection as do offset analog video signals. Balancing the two effects, the FCC has concluded that the average level of any leaking digital signals must be 1.2 dB lower than the level[4] of any leaking analog video signals.[5] Given the FCC's assumption of communication receiver adjacent channel rejection and susceptible RF bandwidth, I do not disagree with this assessment.

In order to ensure that individual signal leaks, and cumulative leakage, from digital signals falls within these new requirements, the FCC has proposed the following changes to the rules:

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[3] The term "digital signals" as used herein refers to wideband RF signals that are quadrature amplitude modulated (QAM) by quantized digital information and which occupy most or all of a 6-MHz channel.

[4] When the "level" of an analog video signal is referred to, it is understood to mean the rms level of the signal as measured during a synchronizing peak, also known as the peak envelope power.

[5] NPRM, paragraph 33.

A) To add lines to the signal leakage requirements table in §76.605(d)[6] creating signal leakage limits for individual digital signals that are 1.2 dB lower than the existing limits for analog signals[7].

B) With respect to cumulative leakage,

(1) To decrease the threshold at which the signal leakage rules become applicable (§76.610) by 1.2 dB for digital signals carried in the aeronautical bands.

(2) To decrease the threshold of leaked digital signal strength (as specified in §76.611(a)(1)) that must be included in the CLI calculation by 1.2 dB.

(3) For "digital cable systems", to decrease the maximum calculated CLI values by 1.2, i.e. from -7 to -8.2 for I_{3000} measurements; from 64 to 62.8 for I_{∞} measurements (§76.611(a)(1)), and from 10 µV/m to 8.7 µV/m for flyover measurements (76.611(a)(2)). No change is suggested for "analog cable systems." and no suggestion is made for how to calculate CLI for systems that carry both analog and digital signals.[8] Furthermore, the requirements for "digital cable systems" refer to including "digital leaks" in the calculation, while CLI-related measurements do not, in fact, measure leakage of either digital or analog cable signals, but only leakage of the test signal specified in §76.611(b).

C) With respect to new plant extensions, to require (§76.611(e)) that the entire plant, including the new section, pass a CLI test or, alternately, that analog systems determine that no signal leak in the new section exceed the 20µV/m criteria of §76.605(d) or, for digital systems, that no signal leak exceed the tighter 17.4 µV/m criteria.

D) With respect to regular monitoring, to require (§76.614) that detection equipment be capable of detecting analog leaks equal to or greater than 20µV/m or digital leaks equal to or greater than 17.4 µV/m in amplitude, and that all such leaks be repaired in a reasonable period of time.

The proposed changes to the table defining maximum allowed leakage of individual cable television signals (§76.605(d)), the changes to the threshold above which signal leakage and CLI become effective (§76.610)), and the changes to the criteria under which new plant extensions can be activated (§76.611(e)) are all consistent with the FCC's goals to control the amplitude of leaked digital signals.

I suggest, however, that the other proposed changes to leakage monitoring and CLI calculations are unnecessarily complex and would result in added costs to operators without any benefit in controlling signal leakage amplitudes.

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[6] In the existing rules, these requirements are at §76.605(a)(12), but are renumbered in the proposed new rule language.

[7] NPRM, paragraph 34.

[8] Although paragraph 37 of the NPRM suggests that adding even one digital signal in the aeronautical bands triggers the new more-stringent CLI and monitoring requirements, the proposed rule language at §76.611(a)(1) only refers to "digital systems" and "analog systems" without defining either term.

Furthermore, in NPRM paragraph 34, the FCC asks about the difficulty of measuring digital signals at the proposed lower thresholds. There are two technical challenges here:

A) Increased sensitivity due to lower signal leakage limits.

Dropping from 20 µV/m to 17.4 µV/m is not a serious technical issue for new equipment designs, though some existing signal leakage meters may not have the sensitivity to accurately measure the lower level signals.

B) The inherent difficulties in measuring wideband digital vs unmodulated or analog video signals.

Aside from the lower threshold, simply measuring low-level leaking digital signals is significantly more difficult than measuring an unmodulated carrier or an analog television signal. In the case of an unmodulated carrier, a signal leakage receiver need only have a bandwidth sufficiently broad to accommodate the combined frequency tolerance of the source and receiver, since all the test signal energy is concentrated at the carrier frequency. The narrow bandwidth reduces thermal noise and keeps other off-air signals from reaching the detector, thereby making accurate low-level measurements possible. A similar technique works with analog television signals, since the majority of the transmitted energy is clustered around the visual carrier.

With a leaking digital signal, however, the energy is evenly spread across the entire 6-MHz channel. For an example of how this affects a measurement, consider that a leakage detector with a 25 kHz bandwidth and a dipole antenna in the presence of a 100 MHz unmodulated test signal whose field strength is 20µV/m will have an input signal of -40.4 dBmV. If the leaking signal were instead a 6-MHz-wide digital signal, however, the received signal level would be only -64.2 dBmV, well below the sensitivity of current leakage measuring instrumentation. While the bandwidth of the leakage receiver can be increased to capture more energy from the signal, the amount of thermal noise and probability of interfering off-air signals degrading the measurement will increase proportionately.

Equipment with the required sensitivity for measuring leaking digital signals is not deployed in any significant quantities.

AN ALTERNATE METHOD THAT FULLY ACCOMPLISHES THE FCC'S GOALS

The goal of the FCC-proposed changes to CLI measurements and routine monitoring procedures is to ensure that, given a distribution plant that meets current CLI performance requirements, any leaking digital signals are at least 1.2 dB lower in amplitude than leaking offset analog video signals so as to have no greater interference potential to aeronautical communications activities.

As noted previously, the existing CLI procedure (§76.611) does not directly measure leaking analog television signals, but rather measures the effective shielding performance of the entire distribution plant of a cable system by annually measuring the leakage of a single test signal at many test locations and calculating an effective shielding figure of merit known as the

Cumulative Leakage Index. Then routine (at least quarterly) monitoring of this same test signal throughout the system, coupled with prompt repair of any detected leaks (§76.614), serves to ensure that the effective shielding is maintained.

With effective shielding performance of the system ensured by meeting the CLI and routine monitoring requirements, the leakage potential of each non-digital communications signal carried through the system is then controlled by requiring that its amplitude not exceed that of the leakage test signal, as required specifically in §76.611(b): "the unmodulated test signal used on the cable plant shall: . . . have an average power level equal to the average power level of the strongest cable television carrier on the system."

Controlling digital signals to ensure that whatever leaks occur are at least 1.2 dB lower in amplitude than would be the case for maximum-allowable-strength analog signals in the same system, therefore, only requires that the levels at which they are carried on the cable plant be at least 1.2 dB lower than the test signal.

Existing paragraph §76.611(b), revised as follows, will therefore fully accomplish the FCC's goals with respect to the amplitude of any leaking digital signals:

> *(b) In paragraphs (a)(1) and (a)(2) of this section the unmodulated test signal used on the cable plant shall: (1) be within the VHF aeronautical band 108-137 MHz or any other frequency ~~in~~ for which results can be correlated to the VHF aeronautical band and (2) have an average power equal to, the greater of (a) the peak envelope power level of the strongest analog cable television carrier on the system, or (b) 1.2 dB greater than the average power level of the strongest digital television signal on the system.*

With this alternate method, **none of the other proposed changes to the leakage measurement and CLI calculation procedures in §76.611 or the quarterly leakage monitoring procedures in §76.614 are required**.

This is far simpler than, as suggested in NPRM paragraph 37, ". . . where an operator transmits any digital signals in the aeronautical bands, the operator would be required to use the digital limits we described above." Under that scenario, as soon as one digital signal is added to an aeronautical band, the CLI requirements would suddenly change. With my procedure, no change is required, because the digital power levels are required to be below the level of the leakage test carrier.

Furthermore, the existing signal leakage detection equipment, its sensitivity, measurement procedures, calculations, and reporting can continue unchanged from current practice. The FCC's goals are achieved by simply adding the requirement that the level of the test signal is at least 1.2 dB stronger than the strongest digital signals. Since both analog and digital signals are accommodated by this method, it is equally applicable to all-analog, all-digital, and hybrid analog/digital cable systems.

Finally, as a practical operating matter, and as required by ANSI/SCTE 40 2011, digital signals

are normally suppressed by six to ten dB relative to analog television signals in systems that carry both, so my proposed alternate method will not require cable operators to change current operating practices and will result in leakage levels of digital signals that are comfortably below the FCC's new proposed requirements.

As systems convert to all-digital signal carriage, this suggested alternate method still defines the use of a CLI/monitoring test carrier as the default measurement method. Should an operator prefer to utilize a different test signal, however, §76.611(c) provides a method by which it can show that its alternative provides equivalent results.

PART II: OTHER SIGNAL LEAKAGE ISSUES

NOTIFICATION THRESHOLDS

In Paragraph 29 of the NPRM, the FCC first notes the existing notification threshold for non-digital signals, then states that "This power threshold and measurement window were developed for analog systems, and an equivalent <u>for digital systems</u> must be selected." This acknowledges that the reporting thresholds for non-digital signals are acceptable as is. But then, in the following paragraphs, the Notice proposes to adopt the threshold for operations in a specific narrow band centered at 406 MHz (§76.616(b)) as the new reporting threshold for all signals at all frequencies, absent any evidence that the existing thresholds are inadequate.

Given its determination in paragraph 33 of the NPRM that leaking broadband digital signals that cannot be offset from emergency communications channel frequencies present a 1.2 dB greater potential interference risk, I suggest that reducing the reporting threshold for those signals from 10^{-4} watts to 75.85 microwatts, while retaining the current threshold for other signals, should fully meet the need for an appropriate threshold for signals that cannot be offset.

Furthermore, the statement in paragraph 31 that "The change proposed above will only affect those systems that are operating a digital channel or channels in the aeronautical band between the existing analog threshold (10^{-4} watts peak power in any 160 microsecond time period) and our proposed digital threshold (10^{-5} watts average power over a 30 kHz bandwidth in any 2.5 millisecond time period)" is not accurate. Many cable systems operate aural subcarriers of analog television channels at levels that fall between 10^{-4} watts and 10^{-5} watts, and so all such systems would have to file new form 321s identifying all such signals that fall into the protected frequency ranges, despite the lack of any evidence that the existing notification threshold for analog signals is inadequate, and also despite the facts that the aural subcarriers present less interference potential that the visual carriers (being 10 to 17 dB lower in amplitude[9]) and that they are already offset as a consequence of the visual carriers being offset.

To prevent this unintended consequence, I suggest rewording §76.1804 to read:

> *An MVPD shall notify the Commission before transmitting <u>any digital signal with average power level exceeding 75.85 microwatts across a 25 kHz bandwidth in any 160</u>*

[9] Per existing §76.605(a)(5) and proposed §75.605(b)(5)

microsecond time period or, for other signal types, any carrier ~~of~~ or other signal component with an average power across a 25 kHz bandwidth in any 160 microsecond time period equal to or greater than 10^{-4} watts at any point in the cable distribution system on any new frequency or frequencies in the aeronautical radio frequency bands (108-137 MHz, 225-400 MHz). The notification shall be made on FCC Form 321. Such notification shall include :. . .

LACK OF NEED FOR DIGITAL SIGNAL LEAKAGE DETECTORS FOR CLI DETERMINATION AND ROUTINE LEAKAGE MONITORING

In paragraph 34, the FCC proposes to "permit the use of analog detectors with this sensitivity [20µV/m] when measuring analog signals in a system which operates no digital signal in the aeronautical bands, but to require analog and digital detectors to have sufficient sensitivity to detect the 1.2 dB decrease in the maximum signal leakage level we propose above, or 17.4 µV/m, in those systems which operate digital signals in the aeronautical bands."

This proposed requirement pertains to "the requirement for regular signal leakage monitoring" and therefore refers to the requirements of §76.614 which utilizes the same equipment as is used to measure signal leakage and calculate CLI. The proposed requirement to "require analog and digital detectors" indicates an apparent misunderstanding of how CLI calculations and regular signal leakage monitoring are performed; regardless of whether analog or digital television signals are transmitted through a cable system, the only signal measured pursuant to the requirements in §76.611 and §76.614 is the unmodulated test signal specified in §76.611(b). Therefore there is no need for a "digital detector" for those measurements. Furthermore, if the simplified CLI and monitoring proposal presented above is accepted, there will be no need for CLI and monitoring receivers to have higher sensitivity than does current equipment.

LACK OF EXISTING EQUIPMENT TO MEASURE DIGITAL AND/OR HIGH FREQUENCY SIGNAL LEAKAGE

As noted above, in NPRM paragraph 34, the FCC proposed establishing signal leakage limits for digital signals that are 1.2 dB lower than the existing limits in §76.605(a)(12). Unlike CLI calculation and routine leakage monitoring, these limits apply to measurements on individual communications signals carried through the cable system's distribution plant. Such measurements would be required, for instance, by an operator prior to activating a plant extension under the provisions of §76.611(e) in lieu of performing a full system leakage measurement and CLI calculation.

In NPRM paragraph 36, the FCC asks about measurement procedures for digital signals (as a possible supplement to §76.609(h)) and, in paragraph 38 of the NPRM, the FCC asks for comments on possibly expanding the frequency range of protected frequency ranges (and thus the range of frequencies for which testing might be required).

As noted earlier, there is little equipment currently deployed that is suitable for direct measurement of leaking digital cable signals due to the greatly increased sensitivity required.

This lack is noted in the *SCTE Measurement Recommended Practices for Cable Systems*[10] and reflects the current state of cable industry measurement capabilities.

Should the rules be modified to require measurement of leaking digital signals at higher frequencies, the problem is further magnified by the decrease in antenna efficiency as frequency increases. For example, as noted earlier, a 20 μV/m unmodulated test signal will result in a -40.4 dBmV signal at the input to a receiver when using a typical test dipole antenna at 100 MHz. At 400 MHz, the meter input level will be 12 dB lower, and at 750 MHz, it will be 17.5 dB lower. Since the level of thermal noise is constant with respect to frequency, the difficulties with making low-level measurements will increase proportionately.

While higher-gain antennas can compensate, in part, for the decreasing antenna efficiency, neither test antennas nor receivers suitable for making such measurements is in common use in the cable industry today. Should measurements be required on digital signals, rather than on unmodulated test signals, the difficulties are significantly greater.

Given these difficulties, I suggest that it is premature to require new measurements until equipment and procedures are widely available to make them.

[10] SCTE Recommended Measurement Practices for Cable Systems, fourth edition, section 12.3 "Signal Leakage, All-Digital System, pp216-217, SCTE 2011.