FCC TECHNICAL STANDARDS

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The Federal Communications Commission received the final report of the Cable Technical Advisory Committee (CTAC) nearly eleven months ago. Some actions to modify cable technical standards are now under way, partly as a result of the CTAC report. Other possible actions are being considered and further researched by the Commission staff. This paper is to report the current status of FCC's re-examination of cable technical standards on the basis of CTAC recommendations and other sources of advice and information.

The purpose of this paper is two-fold. First, I'd like to report to you the current status of FCC staff's re-examination of technical standards for cable television. This re-examination is based in large part on the detailed recommendations and background materials provided to the Commission almost eleven months ago by the Cable Technical Advisory Committee (CTAC) (Ref. 1). Second, I hope to stimulate informal comments from you concerning the specifics of our re-examination.

I want to point out here that these remarks are my own. My comments are meant to be informal and in some cases exploratory, and should not be taken as the opinions of any or all of the Commissioners.

WHY FCC STANDARDS?

Before discussing individual standards we should review the reasons why FCC writes technical standards for cable television. I see four basic functions for technical standards:

- Standards may promote compatibility of equipment and procedures, within a given cable system and among cable systems and other systems with which they interact (broadcasts, video tape recorders, cameras, receivers);

- standards may discourage interference among cable systems and other activities and systems (safety of persons and property, electromagnetic interference both to and from other electronic and electrical systems);

- standards may encourage high quality of service (pictures, sound, reliable data transmission), particularly in those instances where normal market forces may be inadequate; and

- standards may promote or preserve future flexibility, by permitting or encouraging innovation or by preventing short term cost savings from jeopardizing long term savings, flexibility for new services, or long term service quality.

DESIRED CHARACTERISTICS OF STANDARDS

As a framework for discussing possible new or revised standards, let us consider some of the characteristics FCC standards should have in order to perform effectively and at reasonable cost the four functions given above. Then we'll look at our present technical standards and suggest how they might be modified or supplemented to perform those functions.

I would suggest the following as six of the important characteristics that FCC's cable technical standards should have:

A. Must define a "cable television system," its major component subsystems, and its interfaces with other systems (broadcast, recorders, subscriber terminal equipment), in a manner corresponding to the physical reality of cable system architecture. For purposes of technical regulation ownership, signal carriage rules, and political subdivisions within the area served are less relevant.

B. Should include or recognize others' definitions of the most important technical terms, whether the quantity defined is itself subject to regulation or not. Technical definitions are themselves standards, which can help or hinder communication in the technical community and thereby affect the compatibility and/or the quality of cable television systems.

C. Should include mandatory standards and measurements where and only where they are necessary to achieve the four functions given at the beginning of this paper. Unnecessary standards may either stifle innovation or unreasonably increase system costs without commensurate gains in quality of service provided.

D. Should require the least possible complexity, cost, and time, commensurate with performing the desired functions. This criterion is not merely to save a bit of money in making mandatory measurements or filling out bureaucratic forms. Rather, it is hoped that most cable operators will go far beyond the rather minimal measurement requirements specified by the FCC, further improving the quality and reliability of their systems. This is less likely to happen if measurement requirements are unnecessarily complex and costly.

E. Should be sufficiently flexible to permit innovation in cable television and related technologies, and to recognize different circumstances in different types of cable television systems.

F. Must include clear guidelines for reference by cable operators, the public, and FCC inspectors for determining whether the technical standards have actually been met.

PRESENT RULES AND POSSIBLE CHANGES

How do the present rules compare with these criteria, and what changes and additions are actively being considered or proposed by FCC staff? We will consider each in turn, keying the comments to the lettered criteria in the previous section.

A. System and interface definitions. Cable television systems are now defined in the Rules on the basis of communities served. Although a single set of cables may be under common ownership and management, it is considered to comprise two or more separate systems if it serves two or more separate communities. Although this is convenient for dealing with signal carriage rules and franchising arrangements, it is inappropriate for technical standards and measurements.

Action: Staff has proposed to the Commission that for technical regulation only a cable system should be considered to be an electrically and mechanically continuous set of closed or shielded transmission paths used for cable television purposes as described elsewhere in the Rules. This would imply relief from the present requirement for three annual sets of FCC measurements in each community served; on the other hand, separate sets of measurements would be required on each electrically or mechanically separate set of cables, even though they might serve the same community under the same franchise.

In addition, the staff is preparing a proposal, largely following the recommendations of Panel 1 of CTAC, to define in the Rules the major subsystems of cable television systems. Major subsystems include the signal reception unit(s) used for broadcast reception, signal source and control unit(s), and distribution unit(s). Once definitions for these subsystems and for the interfaces between the cable system its signal sources and its subscribers are defined, then standards and measurement requirements can be applied to the appropriate subsystems. A frequency measurement, for example, may need only be made at the signal source unit, whereas signal to noise ratio should be measured at the end of each distribution unit.

B. Definition of technical terms. The Commission received from CTAC's Panel 1 (Ref. 1) many sound and thoughtful recommendations concerning technical definitions. Perhaps the most significant departure from past practice is the recommendation that both thermal noise and signal power be measured relative to the power produced in a 75 ohm load at room temperature over a bandwidth of 3.33 MHz instead of the conventional 4 MHz. At a temperature of 290K (17°C) this noise power works out to be 1/75 pW ($1/75 \times 10^{-12}$ watts). Noise and signal power referenced to this level would be given in "dBc" (for "decibels cable"). The awkward unit "dBmV" would no longer be necessary and signal to noise ratios could be obtained by simple subtraction, once signal and noise were measured relative to 1/75 pW. Present meters calibrated in dBmV would be correctable by simply adding a constant (59.1 dB) to the signal level reading obtained in dBmV from the meter.

Action: The technical staff of the Cable Bureau is now considering the proposed definition of dBc for inclusion in a Rulemaking proceeding, along with other definitions proposed by CTAC Panel 1 and other sources.

C. Choice of mandatory standards and measurements. The present technical standards have, by and large, stood the time-test of the last four years rather well. With the exception of distortion standards originally adopted, they seem to have generally been judged useful standards of system quality and not too onerous to meet and measure. Their existence has clearly caused a number of system operators to obtain test gear and make measurements that had not been made routinely before, and in many cases this process has led to demonstrably higher quality of service. There are striking instances of improved system reliability as a result of measurement programs which began (not ended!) with the required FCC tests.

But today's needs do require some additions and modifications, as was recognized in 1972 when the present standards were adopted. We now examine a few examples in some detail. This is not a complete list of action items. It is a selection chosen to illustrate our general approach and in some cases to prompt informal comments from you. Look at six examples:

(a) frequency channeling plans
(b) cable compatible receivers
(c) signal level
(d) synchronizing pulse amplitude and waveform
(e) time base stability of video tape recorders
(f) distortion measurements

(a) frequency channeling plans

Need: The prime need here is for a frequency plan to be imposed at the interface between the cable system and the subscriber's terminal equipment (TV receiver), as that terminal equipment now exists or may be manufactured in the future. Agreement on such a plan would encourage manufacturers to market receivers which can receive without the use of converters all or any subset of the 20 or more channels expected to be carried on many future cable systems.

One such plan, of course, would be simply to continue use of the VHF and UHF broadcast channels for cable. However, to date the suggestion of delivery of cable signals on UHF frequencies, although technically feasible, has received very little enthusiasm in the cable industry. As UHF tuners continue to improve and as we on this side of the Atlantic learn more about UHF signal delivery on European cable systems, that attitude may well change. CTAC Panel 5 recommended adoption of a plan based on the 12 VHF channel assignments plus a particular choice of midband and superband channels. The recommended choice would put all carriers (except channels 5 and 6) at 6 MHz intervals, which would lend itself to operation of a phase-stable carrier system with its attendant reduction of the effects of intermodulation distortion products.

Action: We are considering whether and how a harmonically related carrier plan or a phase-stable carrier plan based on 6 MHz difference frequencies (except channels 5 and 6) might conceivably be implemented in the future. If it seems likely that phase-stable carrier techniques will become common in the future, then the plan recommended by Panel 5 of CTAC would be an appropriate choice.

(b) cable compatible receivers

Need: Cable-compatible receivers (able to receive more than twelve channels from cable or a full complement of over the air signals without a set-top converter) are needed to promote compatibility among the various subsystems of our overall television delivery system. Such receivers could not only eliminate the inconvenient and expensive set-top converter in many cases, but also would allow fuller use of the frequency spectrum within the cable. Present receivers not only cannot receive directly mid-band and superband channels, but their poor shielding against ambient electromagnetic fields prohibits the use on cable of channels carrying strong over-the-air signals.

Action: In cooperation with receiver manufacturers and the cable industry, we hope to define a marketable cable compatible receiver. Criteria include input impedance (75 ohms), input connector(s), shielding, adjacent channel performance, and lower limits on signal level at which the receiver overloads.

(c) signal level

Need: Some modern receivers overload at input levels of 1 mV (across 75 ohms). But FCC rules require the cable operator to deliver a minimum of 1 mV of signal.

Action: The FCC rules now allow for waivers in specific cases. But in cases like this one, where a problem will occur all over the country wherever such receivers are sold, the rules should specifically provide that the cable operator may deliver a signal which does not meet the normal FCC specifications, when the subscriber's terminal equipment requires such a signal. Such a provision would not, however, solve the operator's problem of having to modify his output signal to match the characteristics of an out-of-the-ordinary receiver. FCC has no jurisdiction over such input characteristics of receivers, so it cannot now simply require manufacturers to accommodate 1 mV signals. If, however, an FCC definition of a "cable compatible receiver" included such a specification, it should at least discourage manufacture of receivers unable to handle a 1 mV signal.

(d) synchronizing pulse amplitude and waveform

Need: If the ratio of peak carrier amplitude to black level in a signal delivered to the receiver is too low, the picture will not be properly synchronized. This is not a common problem in the cable industry, but it has been reported in the case of some cable systems and some receivers. Modern (digital circuit) receivers may be less tolerant than many older receivers.

Action: It may be appropriate to propose synchronizing pulse amplitude and waveform standards patterned after FCC's broadcast standards, but probably with somewhat relaxed tolerances.

(e) time base stability of video tape recorders

Need: Compatibility between low cost video tape recorders and television receivers is desirable. Compatibility may be attained either by (1) use of a time base corrector (expensive) by the cable operator, or (2) a shortened time constant in the horizontal synchronization circuits of the receiver. CTAC recommended the first procedure. It is true that technology improvement is reducing the cost of time base correctors. But it is not clear that it is desirable at this time to impose costs for such items on cable operators. There is presumably at least some market pressure to encourage such expenditures without mandatory standards. To the

extent program material recorded on inexpensive tape recorders is of interest to the public, it is clearly to the cable system operators' benefit if the picture doesn't have its top sheared away. Again, definition of a cable compatible receiver may offer a useful alternative. Appropriately short time constants could be specified as part of the definition.

Action: None at present.

(f) distortion measurements

Need: In principle, measurements of harmonic distortion, cross modulation (cross-picture interference) and other forms of signal distortion are as important as signal level and signal-to-noise measurements as indicators of signal quality. Thus the question of whether distortion standards should be imposed arises.

Action: Adoption of definitions of these quantities would surely improve communications about them within the technical community. But three factors make immediate adoption of mandatory standards and measurement requirements questionable: (1) Once a system has been built and balanced, signal level and signal-to-noise ratio are simpler and reportedly more useful diagnostic measurements to indicate system performance. (2) Measurement of distortion product levels requires much more expensive equipment (e.g., a spectrum analyser) than is normally available to many cable system operators. (3) There is at least some market pressure at work in this instance. Distortion problems are most severe when the system carries more than twelve channels. This is most likely to occur in the larger markets, and in those markets the subscriber usually has one or more good over-the-air signal with which to compare the cable signal. Thus, the large-market subscriber not only is likely to be more critical of signal quality but has at least some alternative to the cable for television entertainment. Thus, the operator is rather likely to be motivated to reduce distortion as much as possible without the existence of mandatory standards and measurements.

D. Minimum complexity, cost, and time. The present technical rules do not seem inordinately complex and costly as they stand. However, we have already initiated some proposals to reduce some unnecessary costs and confusion.

We have already mentioned the proposal to define cable systems for technical purposes in terms of their physical layout rather than in terms of the communities served, thus eliminating unnecessary duplicate measurement requirements.

We have proposed elimination of the requirement to keep on file records of the expected signal level at each subscriber location. The operator may well want this information for his own purposes, but there seems no need for the Commission to require it.

There has been some confusion about whether annual field measurement of subscriber isolation is required, in view of the usual stability of subscriber taps. We have proposed that this measurement requirement be clarified, and that manufacturer's specifications or laboratory measurements on the taps should constitute an acceptable measurement procedure.

E. Flexibility. A certain degree of flexibility is necessary in standards, to prevent stifling of innovation and to recognize that different circumstances might apply in different types of cable systems. The present standards do have such flexibility built in, and future standards will maintain this characteristic. Flexibility is incorporated in at least three ways: (1) the standards are in general set rather on the low side, depending on market forces to encourage higher performance when circumstances permit; (2) the standards are performance standards, not design standards; they are applied to the signal as delivered to the subscriber and do not impose restrictions on techniques the operator should use to obtain the results needed for compatibility and quality; and (3) the rules allow for specific waivers in cases where waivers are in the public interest.

F. Measurements. Last, but certainly not least, FCC technical rules need to specify, for cable operators, the public, and FCC field inspectors how to tell when the standards are being met. These measurement procedures should recognize different cost constraints and different test equipment available from one cable system to another. Until now the approach has been to include a set of optional measurement procedures in the Rules themselves, with a clear statement that other measurement procedures are acceptable to FCC if they meet standards of good engineering practice. (An exception is the measurement of signal leakage or radiation, where a mandatory procedure is specified.) This approach has the advantage of displaying at least one acceptable procedure in a readily accessible place. But it does leave a great deal of ambiguity to be resolved between the cable operator and the inspector in case the cable operator chooses to use a measurement procedure not specified in the Rules.

We are planning, therefore, to publish a collection of measurement procedures, any of which is acceptable for indicating that the relevant standard is met. It is expected that the collection will include both sophisticated measurements using expensive equipment as well as other procedures which require less sophisticated equipment but are still accurate and dependable enough for the purpose at hand. The publication could be in a notebook form which could easily be updated as other measurements became accepted. Of course, the old rule would apply as well -- measurement procedures not included in the publication would be acceptable if they corresponded to good engineering practice. But the publication would contain a wider range of prima facia acceptable procedures than would be practical to include in the Rules themselves. Calibration procedures for test instruments would also be included.

Reference: Cable Technical Advisory Committee Report to the Federal Communications Commission, FCC Report No. FCC-CTB-75-01, May 1975.