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Test Method for Downstream Bit Error Ratio

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1. Introduction

1.1. Executive Summary

Test method for downstream bit error ratio.

1.2. Scope

The purpose of this test is to measure bit error ratio (BER) of downstream (forward path) broadband telecommunications QAM signals. This procedure will address mainly pre-forward error correction BER results for 64- and 256-QAM.

It is important to rely upon both the pre-FEC and post-FEC BER results. In North America, most 64- and 256-QAM signals incorporate ITU-T J.83 Annex B FEC encoding. It is therefore important to reference the post-FEC result, but extremely dangerous to rely solely upon it. BER suffers from what is commonly known as a “cliff effect” in which the post-FEC BER remains error free up to a point and then begins to rapidly decline. Referring to the pre-FEC BER result can yield insight as to how much margin is available prior to reaching the cliff.

Although ITU-T J.83 Annex B is the standard of choice for forward error correction in North America, it can lead to an overoptimistic pre-FEC BER result. When utilizing ITU-T J.83 Annex B, the pre-FEC measurement is after the Trellis decoder, but before the Reed Solomon decoder. Therefore, the Annex B pre-FEC test results will include the improvements of the Trellis coding.

ITU-T J.83 Annex C is similar to Annex B in that it relies on Reed Solomon error correction and occupies a 6 MHz-wide channel; however, Annex C does not incorporate Trellis coding. Since Annex C does not contain Trellis coding, it allows the test to yield a result closer to the true pre-FEC BER performance. Annex C is however, not likely to be the FEC encoding used in the field in North America.

This test is a static measurement at a single, specified device under test (DUT) input level. It does not provide performance over an input operating range. Also, the user will have the option of either testing with Annex B or Annex C. The final test results must clearly indicate which Annex was utilized.

In addition to a bit error ratio measurement, Appendix B refers to the parameters errored and error-free seconds, which can be a useful tool in determining the impairments resulting in the bit errors.

Since the introduction of Cablelabs DOCSIS 3.1 specifications, QAM channels have been sharing the downstream spectrum with OFDM channels. Through Proactive Network Maintenance (PNM), DOCSIS 3.1 specifications leverage CMTS and cable modem features and capabilities to enable measurement and reporting of network conditions and their effects. These measurements include FEC statistics (BER) as measured by cable modems on downstream OFDM channels. Accordingly, the scope of this test was not broadened to cover OFDM channels. Instead, the reader is referred to the DOCSIS 3.1 specifications.

1.3. Benefits

Uniform test method to determine bit error ratio of downstream signals.

1.4. Intended Audience

Equipment manufacturers and technical operations.

1.5. Areas for Further Investigation or to be Added in Future Versions

As bandwidth usage changes additional testing parameters may be added.

2. Normative References

The following documents contain provisions, which, through reference in this text, constitute provisions of this document. At the time of Subcommittee approval, the editions indicated were valid. All documents are subject to revision; and while parties to any agreement based on this document are encouraged to investigate the possibility of applying the most recent editions of the documents listed below, they are reminded that newer editions of those documents might not be compatible with the referenced version.

2.1. SCTE References

- No normative references are applicable.

2.2. Standards from Other Organizations

- No normative references are applicable.

2.3. Published Materials

- ITU-T Recommendation J.83 (1997), Series J: Transmission of Television, Sound Programme and other Multimedia Signals. Digital Transmission of Television Signals.

3. Informative References

The following documents might provide valuable information to the reader but are not required when complying with this document.

3.1. SCTE References

- ANSI/SCTE 96 2013: Cable Telecommunications Testing Guidelines
- SCTE Measurement Recommended Practices for Cable Systems, Fourth Edition, March 2012.

3.2. Standards from Other Organizations

- NCTA Engineering Committee's Subcommittee for Standards of Good Engineering Practices, 2002.
- DOCSIS 3.1, Physical Layer Specification, CM-SP-PHYv3.1-I13-171220, December 20, 2017, Cable Television Laboratories, Inc.

3.3. Published Materials

- Edgington, Francis and Thomas, Jeffrey. Digital Basics For Cable Television Systems. Upper Saddle River: Prentice Hall PTR, 1999.