



ATIS-0100514.2009(S2019)

Network Performance Parameter and Objectives for
Dedicated Digital Services – SONET Bit Rates

AMERICAN NATIONAL STANDARD FOR TELECOMMUNICATIONS



ATIS is the leading technical planning and standards development organization committed to the rapid development of global, market-driven standards for the information, entertainment and communications industry. More than 200 companies actively formulate standards in ATIS' Committees, covering issues including: IPTV, Cloud Services, Energy Efficiency, IP-Based and Wireless Technologies, Quality of Service, Billing and Operational Support, Emergency Services, Architectural Platforms and Emerging Networks. In addition, numerous Incubators, Focus and Exploratory Groups address evolving industry priorities including Smart Grid, Machine-to-Machine, Networked Car, IP Downloadable Security, Policy Management and Network Optimization.

ATIS is the North American Organizational Partner for the 3rd Generation Partnership Project (3GPP), a member and major U.S. contributor to the International Telecommunication Union (ITU) Radio and Telecommunications' Sectors, and a member of the Inter-American Telecommunication Commission (CITEL). ATIS is accredited by the American National Standards Institute (ANSI). For more information, please visit < <http://www.atis.org> >.

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires review by ANSI that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer.

Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached (by vote) and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that a concerted effort be made towards their resolution.

The use of American National Standards is completely voluntary; their existence does not in any respect preclude anyone, whether he has approved the standards or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards.

The American National Standards Institute does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on the title page of this standard.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedure of the American National Standards Institute require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute.

Notice of Disclaimer & Limitation of Liability

The information provided in this document is directed solely to professionals who have the appropriate degree of experience to understand and interpret its contents in accordance with generally accepted engineering or other professional standards and applicable regulations. No recommendation as to products or vendors is made or should be implied.

NO REPRESENTATION OR WARRANTY IS MADE THAT THE INFORMATION IS TECHNICALLY ACCURATE OR SUFFICIENT OR CONFORMS TO ANY STATUTE, GOVERNMENTAL RULE OR REGULATION, AND FURTHER, NO REPRESENTATION OR WARRANTY IS MADE OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR AGAINST INFRINGEMENT OF INTELLECTUAL PROPERTY RIGHTS. ATIS SHALL NOT BE LIABLE, BEYOND THE AMOUNT OF ANY SUM RECEIVED IN PAYMENT BY ATIS FOR THIS DOCUMENT, WITH RESPECT TO ANY CLAIM, AND IN NO EVENT SHALL ATIS BE LIABLE FOR LOST PROFITS OR OTHER INCIDENTAL OR CONSEQUENTIAL DAMAGES. ATIS EXPRESSLY ADVISES ANY AND ALL USE OF OR RELIANCE UPON THIS INFORMATION PROVIDED IN THIS DOCUMENT IS AT THE RISK OF THE USER.

NOTE - The user's attention is called to the possibility that compliance with this standard may require use of an invention covered by patent rights. By publication of this standard, no position is taken with respect to whether use of an invention covered by patent rights will be required, and if any such use is required no position is taken regarding the validity of this claim or any patent rights in connection therewith.

ATIS-0100514.2009(S2019) Network Performance Parameters and Objectives for Dedicated Digital Services - SONET Bit Rates

Is an American National Standard developed by the **Quality of Service (QoS) Task Force** under the **ATIS Network Performance, Reliability and Quality of Service Committee (PRQC)**.

Published by
Alliance for Telecommunications Industry Solutions
1200 G Street, N.W., Suite 500
Washington, DC 20005

Copyright © 2019 by Alliance for Telecommunications Industry Solutions
All rights reserved.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher. For information contact ATIS at 202.628.6380. ATIS is online at < <http://www.atis.org> >.

Printed in the United States of America.

American National Standard for Telecommunications

Network Performance Parameters and Objectives for Dedicated Digital Services – SONET Bit Rates

Alliance for Telecommunications Industry Solutions

Approved March 23, 2009

American National Standards Institute, Inc.

Abstract

This standard defines the parameters and establishes objectives for assessing the performance of dedicated digital services operating at the nominal 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2.488 Gbit/s, and 9.865 Gbit/s interface rates of the SONET (Synchronous Optical Network) digital hierarchy. Rates above 9.865 Gbit/s and SONET virtual tributaries are for further study.

The standard defines the framework for specifying accuracy and availability performance and the allocation of end-to-end performance objectives among service providers. The performance objectives are applicable to each direction of the service between network interfaces. Performance impairments originated outside the network interfaces, such as those due to end-user actions are not included in evaluating performance. The standard further provides acceptance and repair verification test limits for SONET services. The parameter definitions are block based, making in-service measures convenient.

FOREWORD

The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. As such, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the standard.

The Alliance for Telecommunication Industry Solutions (ATIS) serves the public through improved understanding between providers, customers, and manufacturers. The Network Performance, Reliability, and Quality of Service Committee (PRQC) develops and recommends standards, requirements, and technical reports related to the performance, reliability, and associated security aspects of communications networks, as well as the processing of voice, audio, data, image, and video signals, and their multimedia integration. PRQC also develops and recommends positions on, and fosters consistency with, standards and related subjects under consideration in other North American and international standards bodies.

This standard will be useful to providers and users of digital communications services and also to designers of network and terminal equipment and service applications. This standard provides error performance parameters, measurement methods, numerical specifications, and allocations for dedicated digital communications services operating at specific rates of the SONET (Synchronous Optical Network) digital hierarchy. This standard provides the means to verify the accuracy and availability performance of dedicated digital services operating at nominal interface rates of 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2.488 Gbit/s, and 9.865 Gbit/s. Included mappings of performance measures to SONET monitoring functions allow establishing compliance with this standard on an in-service basis.

ANSI guidelines specify two categories of requirements: mandatory and recommendation. The mandatory requirements are designated by the word *shall* and recommendations by the word *should*. Where both a mandatory requirement and a recommendation are specified for the same criterion, the recommendation represents a goal currently identifiable as having distinct compatibility or performance advantages.

There are four annexes in this standard. Annex A is normative and is considered part of this standard. Annexes B through D are informative, and are not considered part of this standard.

Suggestions for improvement of this standard are welcome. They should be sent to Alliance for Telecommunications Industry Solutions, Suite 500, 1200 G Street NW, Washington, DC 20005.

M. Neibert, PRQC Chair (Telcordia)

C. Underkoffler, ATIS Chief Editor

The **QoS** Task Force was responsible for the development of this document.

TABLE OF CONTENTS

1	SCOPE, PURPOSE, & APPLICATION	1
2	NORMATIVE REFERENCES	1
3	DEFINITIONS, ACRONYMS, & ABBREVIATIONS	2
3.1	DEFINITIONS	3
3.2	ACRONYMS & ABBREVIATIONS.....	3
4	REFERENCE MODEL	3
5	ERROR PERFORMANCE PARAMETERS AND BLOCK SIZES	4
5.1	BLOCK SIZES FOR ASSESSING PERFORMANCE.....	4
5.2	ERROR PERFORMANCE PARAMETERS.....	4
6	DERIVATION OF END-TO-END OBJECTIVES	5
7	PERFORMANCE OBJECTIVES	5
7.1	RATIONALE	5
7.2	ACCURACY OBJECTIVES	5
7.3	AVAILABILITY OBJECTIVES.....	6
8	TEST DESIGN	7
8.1	RATIONALE	7
8.1.1	ACCEPTANCE TESTS	8
8.1.2	REPAIR VERIFICATION TESTS	8
8.1.3	TROUBLE VERIFICATION TESTS.....	8
8.2	PERFORMANCE DETERMINATION	8
8.2.1	PARAMETERS MEASURED	8
8.2.2	TEST DURATION.....	8
9	SERVICE PERFORMANCE TESTING	8
9.1	TESTS FOR 51.84, 155.52, 622.08 MBIT/S, 2.488 GBIT/S, AND 9.865 GBIT/S SERVICES	9
9.2	TEST PROCEDURES	9
9.2.1	SHORT DURATION TESTS	9
9.2.2	LONG DURATION TESTS	9
9.3	ACCEPTANCE AND REPAIR VERIFICATION TEST LIMIT TABLES.....	9
ANNEX A	IN-SERVICE AND OUT-OF-SERVICE MEASUREMENTS USING THE SONET PATH PERFORMANCE MEASUREMENTS	13
A.1	ESTIMATING ERRORED BLOCKS.....	13
A.1.1	DIRECT ESTIMATION OF ERRORED BLOCKS USING THE B3 BYTE.....	13
A.1.2	APPROXIMATION OF ERRORED BLOCKS USING INDIVIDUAL BIP COUNTS.....	13
A.2	ESTIMATING ERRORED SECONDS.....	13
A.3	ESTIMATING SEVERELY ERRORED SECONDS	13
A.3.1	USE OF BIP COUNTS.....	14
A.3.2	USE OF PATH PERFORMANCE DEFECTS.....	14
A.4	ESTIMATION OF PERFORMANCE EVENTS AT THE FAR-END OF A PATH	14
A.5	AVAILABILITY PHILOSOPHY	14
ANNEX B	DERIVATION OF TEST LIMITS	16
B.1	INTRODUCTION	16

B.2	SUMMARY OF PROCEDURE.....	17
B.2.1	OBJECTIVE PARAMETERS	17
B.2.2	SUBJECTIVE PARAMETERS	17
B.2.3	THE STEPS	18
B.3	ERROR PROBABILITY DISTRIBUTIONS	18
B.4	MODEL FOR THE CIRCUIT POPULATION.....	20
B.5	THE HYPOTHESES H_G AND H_B : WEIGHT OF EVIDENCE	21
B.6	USING THE TEST RESULTS TO MAKE DECISIONS	22
B.7	THE WEIGHT OF EVIDENCE METHOD USED FOR SONET TEST LIMITS	24
B.7.1	THE SUBJECTIVE PARAMETERS.....	24
B.7.1.1	A AND B	24
B.7.1.2	α AND L.....	25
B.7.2	ERRORED SECOND TABLES.....	25
B.7.3	SEVERELY-ERRORED SECOND TABLES	26
B.7.4	BACKGROUND BLOCK ERROR TABLES.....	26
ANNEX C	APPROXIMATION OF ERRORED BLOCKS USING INDIVIDUAL EP COUNTS FOR BURST ERROR CASES.....	34
C.1	RELATION BETWEEN AVERAGE BURST SIZE AND AVERAGE NUMBER OF CODE VIOLATIONS PER ERRORED BLOCK	34
C.2	CASES WHERE FORWARD ERROR CORRECTION (FEC) IS USED	38
C.3	REFERENCES.....	39
ANNEX D	BIBLIOGRAPHY	40

TABLE OF FIGURES

FIGURE 1 - REFERENCE MODEL - SONET DEDICATED DIGITAL SERVICE.....4

FIGURE B. 1 - A POPULATION OF CIRCUITS, EACH CHARACTERIZED BY A VALUE OF P OR \bar{E} **ERROR! BOOKMARK NOT DEFINED.**

FIGURE B. 2 - ERRORED SECONDS: THE BETA PRIORS FOR THE PARAMETER $E = nNp$ OF THE "GOOD" AND "BAD" CIRCUIT POPULATIONS..... **ERROR! BOOKMARK NOT DEFINED.**

FIGURE B. 3 - SEVERELY ERRORED SECONDS: THE BETA PRIORS FOR THE PARAMETER $E = nNp$ OF THE "GOOD" AND "BAD" CIRCUIT POPULATIONS **ERROR! BOOKMARK NOT DEFINED.**

TABLE OF TABLES

TABLE 1 - BLOCK SIZE.....4

TABLE 2 - LONG-TERM ACCURACY OBJECTIVES6

TABLE 3 - SERVICE AVAILABILITY OBJECTIVES7

TABLE 4 - TEST CRITERIA9

TABLE 5 - ACCEPTANCE AND REPAIR VERIFICATION TEST LIMITS FOR 51.84 MBIT/S SERVICE.....10

TABLE 6 - ACCEPTANCE AND REPAIR VERIFICATION TEST LIMITS FOR 155.52 MBIT/S SERVICE.....10

TABLE 7 - ACCEPTANCE AND REPAIR VERIFICATION TEST LIMITS FOR 622.08 MBIT/S SERVICE.....11

TABLE 8 - ACCEPTANCE AND REPAIR VERIFICATION TEST LIMITS FOR 2.488 GBIT/S SERVICE.....11

TABLE 9 - ACCEPTANCE AND REPAIR VERIFICATION TEST LIMITS FOR 9.955 GBIT/S SERVICE.....12

TABLE A. 1 - COUNT OF X FOR SES **ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 1 - SPECIFICATION OF A SIMPLE COST (LOSS) FUNCTION FOR THE TEST.....**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 2 - THE CRITICAL (NON-LOG) WEIGHT OF EVIDENCE \hat{W} FOR VARIOUS L AND α**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 3 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.125% ES (108 ES/DAY)**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 4 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.25% ES (216 ES/DAY).....**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 5 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.5% ES (432 ES/DAY)**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 6 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.01% SES (8.64 SES/DAY).**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 7 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.025% SES (21.6 SES/DAY).....**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 8 - WEIGHT OF EVIDENCE W FOR OBJECTIVE OF 0.035% SES (30.24 SES/DAY).....**ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 9 - WEIGHT OF EVIDENCE FOR BBER OBJECTIVE OF 10^{-5} (CASE 1, END-TO-END OBJECTIVE FOR STS-12C AND STS-48C) **ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 10 - WEIGHT OF EVIDENCE FOR BBER OBJECTIVE OF 5×10^{-6} (CASE 2, ACCESS AND TRANSIT PORTION ALLOCATION FOR STS-12C AND STS-48C)..... **ERROR! BOOKMARK NOT DEFINED.**

TABLE B. 11 - WEIGHT OF EVIDENCE FOR BBER OBJECTIVE OF 10^{-4} (CASE 3, END-TO-END OBJECTIVE FOR STS-192C) **ERROR! BOOKMARK NOT DEFINED.**

ATIS-0100514.2009 (S2019)

TABLE B. 12 - WEIGHT OF EVIDENCE FOR BBER OBJECTIVE OF 5×10^{-5} (CASE 4, ACCESS AND TRANSIT PORTION ALLOCATION FOR STS-192C) **ERROR! BOOKMARK NOT DEFINED.**

TABLE C. 1 - AVERAGE NUMBER OF CODE VIOLATIONS PER ERRORED BLOCK, K, AS A FUNCTION OF AVERAGE BURST SIZE..... **ERROR! BOOKMARK NOT DEFINED.**

Currently in preview, click buy full version

American National Standard for Telecommunications –

Network Performance Parameters and Objectives for Dedicated Digital Services – SONET Bit Rates

1 SCOPE, PURPOSE, & APPLICATION

This standard defines the parameters and establishes objectives for assessing the performance of dedicated digital services operating at the nominal 51.84 Mbit/s, 155.52 Mbit/s, 622.08 Mbit/s, 2.488 Gbit/s, and 9.865 Gbit/s interface rates of the SONET (Synchronous Optical Network) digital hierarchy. Rates above 9.865 Gbit/s and SONET virtual tributaries are for further study.

This standard defines the framework for specifying accuracy and availability performance and the allocation of end-to-end performance objectives among service providers. The performance objectives are applicable to each direction of the service between network interfaces. Performance impairments originated outside the network interfaces, such as those due to end-user actions are not included in evaluating performance. The parameter definitions are block based, making in-service measures convenient. The mappings given in Annex A shall be sufficient for establishing in-service or out-of-service conformance to this standard.

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in the text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below.

ATIS-0900105.2008, *Telecommunications – Digital hierarchy – Synchronous Optical Network (SONET) - Basic Description including Multiplex Structure, Rates and Formats.*¹

ATIS-0300231.2003(R2007), *Telecommunications – Digital Hierarchy – Layer 1 In-Service Digital Transmission Performance Monitoring.*¹

ATIS-0100503.2002(R2004), *Telecommunications – Network Performance Parameters for Dedicated Digital Services – Definitions and Measurements.*¹

ATIS-0100510.095(R2008), *Telecommunications – Network Performance Parameters for Dedicated Digital Services – Specifications.*¹

ANSI/FEEC 1007-1991, *Methods and equipment for measuring the transmission characteristics of pulse-code modulation (PCM) telecommunications circuits and systems.*²

¹ This document is available from the Alliance for Telecommunications Industry Solutions, 1200 G Street N.W., Suite 500, Washington, DC 20005. <<http://www.atis.org>>.

² This document is available from the Institute of Electrical and Electronic Engineers. <<http://www.ieee.org>>.