NISTIR 4594

GOSIP Conformance and Interoperation Testing and Registration

J. Stephen Nightingale
Principal Author

March 1991 - Version 1.0

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
GOSIP Testing Program
Computer Systems Laboratory
Gaithersburg, MD 20899

U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
John W. Lyons, Director

NIST

NISTIR 4594

GOSIP Conformance and Interoperation Testing and Registration

J. Stephen Nightingale
Principal Author

March 1991 - Version 1.0

U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
GOSIP Testing Program
Computer Systems Laboratory
Gaithersburg, MD 20899

U.S. DEPARTMENT OF COMMERCE
Robert A. Mosbacher, Secretary

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
John W. Lyons, Director

FOREWORD

This publication, **"GOSIP Conformance and Interoperation Testing and Registration"** is expected to be published as a guideline in the Federal Information Processing Standard series later in 1991. The provisions of GOSIP Version 1.0 (FIPS 146) became mandatory requirements for acquisition of new computer networking products and services as of August 15, 1990. This document contains guidelines for agencies wishing to specify testing requirements for acquisitions involving GOSIP implementations. Any agency referencing this report in an acquisition action is advised to make these testing provisions an agency requirement.

In parallel with this report, NIST is establishing and operating the Registration procedures described herein, together with the associated Means of Testing assessment and GOSIP Conformance Test Laboratory Accreditation.

NIST Computer Systems Laboratory
March, 1991

TABLE OF CONTENTS

PART II: TECHNICAL CRITERIA FOR GOSIP VERSION 1.0

OVERVIEW

The development of Federal Information Processing Standard (FIPS) 146 which specifies the **Government Open Systems Interconnection Profile (GOSIP)** [NIST 1], resulted in the need to establish policy and procedures aimed at ensuring that Federally procured data communications products adhere to the technical documents referenced by GOSIP and that they interoperate. The goal of this report is to aid a Federal Acquisition Authority in procurement of GOSIP products by employing publicly accessible registers verifying supplier claims of conformance and documenting instances of interoperability of GOSIP conformant products.

To achieve this goal, this report references other publicly accessible registers, other publications, and works conducted under the auspices of:

- the National Voluntary Laboratory Accreditation Program,
- the OSI Implementors' Workshop,
- the Computer Systems Laboratory or its designated Agent, and
- the International Organization for Standardization (ISO).

This report describes the use of ISO's OSI Conformance Testing Methodology and Framework [ISO 1] for the purposes of GOSIP testing.

This is a multi-part report in which the policy, procedures and testing mechanisms for GOSIP products are specified in Part I; Part II describes specific testing criteria for GOSIP Version 1.0 protocols. The framework provided herein may be extended as subsequent versions of GOSIP are issued.

This report identifies requirements for conformance testing and interoperability testing of GOSIP protocols (and protocol stacks). The framework includes comprehensive GOSIP testing through use of a test laboratory accreditation program. In order to effectively realize the goal of GOSIP, products which interoperate and are available off-the-shelf for Government procurement, issues identified below are addressed by the report.

- **Conformance Testing**: Policy, procedures and criteria are identified. Conformance testing shall be conducted by accredited test laboratories using assessed and registered Means of Testing. Registered results of conformance testing will be published periodically for purposes of Federal procurement. Mutual recognition of other conformance testing authorities' results will be considered using these criteria

as a basis.

- **Interoperability Testing**: For suppliers claiming GOSIP conformance, interoperability testing against a Registered GOSIP Reference Entity is advised for GOSIP application and relay stacks. Criteria and procedures are identified to select and register one reference entity for each GOSIP application stack. NIST will solicit, select and register GOSIP Reference Entities meeting criteria specified; this does not preclude NIST's providing reference entities which meet the same criteria. This interoperability testing is advised if and only if GOSIP Reference Entities are selected and registered. NIST (or its agent) conducts interoperability testing between vendors products and GOSIP Reference Entities using NIST registered Interoperability Test Suites. Supplier-to-supplier interoperability testing of GOSIP products may be conducted resulting in addition to a NIST approved register.

  Any forum in which Interoperability testing is conducted which uses registered Interoperability Test Suites and which meets the criteria specified herein may be approved as a registered Interoperability Testing Service.

- **Laboratory Accreditation**: Policies and procedures are published under the auspices of the National Voluntary Laboratory Accreditation Program (NVLAP) and include: policy, procedures and criteria to determine that candidate test laboratories are qualified to conduct GOSIP product testing; procedures and criteria to determine that registered test methods are employed by candidate test laboratories.

- **Abstract Test Suites**: Criteria identified for test suite coverage in this report will be applied to identify or develop, amend as necessary, and maintain a set of Abstract Test Suites for GOSIP. Abstract test suites registered by the NIST will be used as the standard reference for the assessment of Means of Testing in this report.

- **Public Registers**: Registers shall be maintained and published periodically for the following:

  1) Accredited test laboratories;
  2) Qualified Means of Testing;
  3) Abstract test suites for GOSIP;
  4) NIST supplied reference entities;
  5) Successfully conformance tested GOSIP products;

6) Successfully interoperability tested GOSIP products;
7) GOSIP Interoperability Test Suites;
8) Interoperability Testing and Registration Services.

This report does not distinguish between a conformance testing laboratory which is first party (self-testing) or third party (independent of product supplier), however each Acquisition Authority may choose to require third party testing, at its own option.

The relationships between FIPS 146 GOSIP and the "GOSIP Conformance and Interoperation Testing and Registration" report are as follows:

1) GOSIP shall be used by Federal Government Agencies when acquiring computer network products and services and communications systems or services that provide equivalent functionality to the protocols defined in the GOSIP FIPS 146 and referenced standards.

2) If a supplier claims GOSIP compliance or conformance for a product then the Agency is advised to require that product to be tested in accordance with the criteria specified in the GOSIP Conformance and Interoperation Testing and Registration report. If the product includes a multi-layered GOSIP profile then all protocols for which GOSIP compliance or conformance is claimed should be tested in accordance with these criteria.

3) Federal Government Agencies requiring verification of suppliers claims of GOSIP conformance should consult the Register of Conformance Tested GOSIP Products.

4) Federal Government Agencies wishing to procure OSI products that are not on the register are advised to arrange that the product qualify for registration prior to final acceptance.

5) Federal Government Agencies requiring an increased confidence that GOSIP conformant products will interoperate should consult the register of successfully interoperability tested GOSIP products, if a NIST supplied reference implementation is registered for the protocol stack in question.

6) Federal Government Agencies should consult the data supplied by a service on the register of Interoperability Test and Registration Services under any of these conditions:

a) The agency requires increased confidence that a specific GOSIP conformant product is interoperable and no NIST supplied reference implementation is registered for the protocol stack.

b) The agency requires that multiple instances of successful interoperation are documented for a specific GOSIP conformant product.

c) The agency requires that an instance of successful interoperation is documented for one or more specific pairs of GOSIP conformant products.

GOSIP CONFORMANCE AND INTEROPERATION TESTING AND REGISTRATION

PART I: GENERAL REQUIREMENTS FOR TESTING GOSIP

1. INTRODUCTION

Acceptance of vendor products for use within Government operations is the responsibility of the Acquisition Authority. Normally, an Acquisition Authority develops an acceptance test plan to evaluate the functional and performance characteristics of proposed products against requirements specified within a request for proposal (RFP). When an Acquisition Authority introduces a requirement for standards compliance within an RFP, a new testing issue is created - determining compliance of proposed products with the standard. When a data communication's standard, such as the Government Open Systems Interconnection Profile (GOSIP) [NIST 1] is cited, an additional testing issue arises - determining interoperability between proposed products and existing products that are known to comply with the GOSIP.

The GOSIP Conformance and Interoperation Testing and Registration is intended to provide the Acquisition Authority with as much assistance as possible to determine compliance to GOSIP and to demonstrate interoperability between vendor products purporting to comply with GOSIP. The Acquisition Authority should reserve the right to test proposed products against more stringent criteria should the need exist and should the cost be justified. In such cases, the following GOSIP test policy will provide a significant foundation.

1.1 Background

The National Institute of Standards and Technology (NIST), Computer Systems Laboratory (CSL) is responsible for developing U.S. Government-wide Standards for data communications networks and related telecommunication systems. The authority for this responsibility is assigned under the Federal Property and Administrative Services Act of 1949, as amended by Public Law 100-235.

NIST CSL develops standards, provides technical assistance, and carries out research to advance the effective use of computers by government and industry. NIST CSL works through voluntary industry standards organizations to develop standards that will meet the needs of government users. These standards are issued as Federal Information Processing Standards (FIPS) and provide the foundation for compatibility and, where necessary, interoperability between government systems implementing these standards. FIPS also serve as the basis for Government acquisition of commercial off-the-shelf **products** and services from competitive sources.

The pace of standards development for data communications networks and telecommunications has intensified in recent years, stimulated by user needs for interconnectivity of hardware, software, and network systems. These standards are increasingly complex--often describing functional requirements and allowing for numerous options in implementation.

To achieve interoperability and effective use of information systems, users need off-the-shelf products that work together and conform to these emerging standards. Where products are expected to support complex standards specifications, conformance testing may be required to reduce risks and raise consumer confidence in information system products.

NIST CSL is responsible for organizing, managing, directing and administering the FIPS program. Among the responsibilities assigned under the FIPS program is the task of insuring that, for products to be acquired by the Federal Government, a mechanism is available for determining that these products conform to the FIPS. In carrying out this task, the NIST CSL develops and maintains conformance testing programs for the FIPS. These programs require adequate test methods and procedures, suitable candidate test laboratories for accreditation, and a formal acknowledgement of product testing for compliance or noncompliance to a FIPS.

1.2 Purpose

This document is intended to inform Government agencies, industry, standards development bodies, and other interested organizations of the NIST CSL policy with regard to conformance testing and interoperability testing of GOSIP products which are conformant and interoperable.

The purpose of this report is to provide the framework for uniform Government-wide procurement of GOSIP conformant products.
The objectives of GOSIP Conformance and Interoperation Testing and Registration are:

- To reduce the overall information systems costs by making it easier and less expensive to maintain information technology applications and to transfer these applications among different information systems, including replacement systems;

- To protect the technical assets and staff time of the Federal Government by insuring to the extent possible that products (off-the-shelf or government developed) brought into the

Federal inventory comply with Government approved FIPS;

- To identify test methods and competent test laboratories for assisting Government agencies in the procurement of industry supplied GOSIP products;

- To increase the likelihood of interoperability of GOSIP conformant products.

Further detailed solutions to the guidelines in this report are given in companion handbooks:

The "NVLAP Program Handbook: Operational Requirements of the Laboratory Accreditation Program for GOSIP Conformance Testing" [NIST 6] provides the administrative procedures for NVLAP accreditation.

The "Government Open Systems Interconnection Profile (GOSIP) Means of Testing Assessment Handbook" [NIST 7] explains the technical and administrative procedures for the assessment of MOTs for GOSIP protocols.

The "Government Open Systems Interconnection Profile (GOSIP) Registration Criteria" handbook [NIST 8] identifies the registers of tests, test systems, laboratories and products and describes the administrative criteria for registration.

1.3 Scope

This report provides detailed advisory provisions with respect to conformance and interoperability testing given in FIPS 146 **Government Open Systems Interconnection Profile (GOSIP) Version 1.0.** This report defines policy and procedures related to conformance testing and interoperability testing for GOSIP. Other types of testing such as performance, acceptance, and quality testing, are not addressed.

In determining testing requirements for GOSIP, a number of areas are considered: Government testing needs, test method technology, standard specifications, alternative testing sources (third-party testing, Government testing, self-testing, etc.), and existing accreditation and certification systems.

The policy and procedures for conformance testing and for interoperability testing defined herein apply whenever GOSIP standards are required to support Government objectives for

information systems.

The report is addressed to:

1) Agencies of the Federal Government intending to procure OSI products;

2) Suppliers of OSI products wishing to market to the Federal Government;

3) Suppliers of OSI test services seeking accreditation as a test laboratory;

4) Developers of the means of testing OSI products wishing to supply to accredited laboratories.

5) Suppliers of OSI interoperability testing and registration services seeking recognition by the Federal Government.

The program of registration will be administered by the NIST CSL, or its appointed agent, who will have authority delegated by the Director of CSL. In the text that follows the acronym "NIST CSL*" is used to mean "NIST CSL or its agent".

1.4 Overview of Testing

This report is concerned with conformance and interoperability testing from the point of view of both their conduct and the evaluation of their methods. To eliminate confusion over which role is being addressed this report draws the distinction between the terms assessment and accreditation on the one hand, and testing on the other.

Testing means using tools, facilities and procedures to establish that implementations of GOSIP related products are conformant and/or interoperable.

Assessment is the process of determining that testing tools are fit for their declared purpose.

Accreditation is the administrative act of recognizing that
1) a test laboratory is qualified to conduct protocol testing after having met specific technical and organizational criteria, and
2) the means of testing employed by a test laboratory meets specific technical criteria.

Registration is the administrative act of recognizing that the tested products meet specified criteria by registering the results after successful testing has been conducted.

Within the International Organization for Standardization (ISO) conformance testing methodology has developed and is the subject of a separate standard (IS 9646 OSI Conformance Testing Methodology and Framework) [ISO 1]. Its purpose is to define standardized methods which may be used for conformance testing and to define relationships between: 1) parties supplying the means of testing OSI protocols and test laboratories, and 2) test laboratories and their clients, and the information exchanged between them. Conformance testing concentrates on determining whether an implementation of a protocol conforms to both static and dynamic requirements specified in a protocol standard.

Current conformance testing technology provides for tools which separate the testing concerns of any 7-layer OSI stack into three functional groups:

- Upper Layers: Session, Presentation, Application
- Intermediate Layers: Network, Transport
- Lower Layers: Physical, Link

Higher layer protocols are tested, and operated, over a stack of supporting protocols. IS 9646 prescribes testing of the lower layer protocols prior to testing the protocols which they support. One reason for this arrangement is that direct access to a layer service affords the greatest possible capability of controlling and observing events within that layer. Another reason is that the development of the means of testing followed the development of protocol stack implementations, and the means of testing for lower layer protocols were available earliest. An advantage afforded by this approach is that the Protocol Conformance Test Report (PCTR) can be used in support of incremental testing, specifically so that full regression testing is not needed in testing a larger stack which builds on the already tested functionality.

Full-stack testing is also an alternative, although no 7-layer means of testing is currently in existence. Full stack methods require that each protocol in the stack be tested by embedded methods (except the Application protocols which are tested by single-layer methods). This procedure is repeated for every new Application stack, since each new service user may exercise paths within a lower layer protocol which are not explored by a

different service user in another full stack.

More recently interoperability testing has been identified as a necessary step in demonstrating interworking of OSI implementations. Whereas the failures in conformance testing are likely to be software errors, interworking problems seem more likely to include problems of parameter range selection, plus attempts to use incompatible stacks, attempts to use optional functions not implemented, and failures to implement mandatory functions. Consequently, interoperability assurance will be developed iteratively by testing and tuning. The methodology and test suites employed are subject to the criteria given in clause 6.3. Since it is necessary to assess the interoperability of systems, this report identifies two steps: testing against a government supplied reference entity, and multi-vendor bilateral interoperability testing.

1.5 Organization of this Report

This report provides the overall procedures for the operation of the GOSIP testing and registration program, and specific technical criteria pertaining to GOSIP protocols and profiles. Consequently this report is organized into separate but related parts: Part I provides the overall policy and operational criteria; Part II provides technical criteria for GOSIP Version 1.0; future versions of GOSIP will be the subject of further technical increments to this report or the associated FIPS.

1.6 Definitions

Abstract Test Case: A complete and independent specification of the actions required to achieve a specific test purpose (or a specified combination of test purposes), defined at the level of abstraction of a particular abstract test method. It may include a preamble and postamble to ensure starting and ending in a stable state (i.e. an identifiable stable state of the System Under Test which can be easily reached and maintained, such as the 'idle' state or the 'data transfer' state). This specification may involve one or more consecutive or concurrent connections.

Abstract Test Method: The description of how an Implementation Under Test is to be tested, given at an appropriate level of abstraction to make the description independent of any particular implementation of testing tools, but with enough detail to enable tests to be specified for this test method.

Acceptance Testing: Formal testing conducted to determine whether or not a system satisfies its acceptance criteria and to enable the customer to determine whether to accept the system. Formal testing may include the planning and execution of several kinds of tests (e. g., functional, volume, performance tests) to demonstrate that the implementation satisfies the customer requirements.

Accreditation Body: An impartial body, governmental or nongovernmental, possessing the necessary competence and reliability to operate or accredit operation of an accreditation system, and in which the interests of all parties concerned with the function of the system are represented.

Basic Interconnection Tests: Limited tests of an Implementation Under Test (IUT) to determine whether or not there is sufficient conformance to the relevant protocol(s) for interconnection to be possible, without trying to perform thorough testing.

Behavior Tests: Tests to determine the extent to which the dynamic conformance requirements are met by the IUT.

Capability Tests: Tests to determine the capabilities of an IUT. (Note, this involves checking all mandatory capabilities and those optional ones that are stated in the Protocol Implementation Conformance Statement (PICS) as supported, but not checking those optional ones which are stated in the PICS as not supported by the IUT.)

Conformance: In the context of OSI a real system is said to exhibit conformance if it complies with the requirements of applicable OSI standards in its communication with other real systems.

Conformance Testing: Testing the extent to which an IUT is a conforming implementation.

Coordinated Test Method: An external test method for which a standardized test management protocol is defined as the test coordination procedures, enabling the control and observation to be specified solely in terms of the lower tester activity, including the control and observation of test management PDUs.

Distributed Test Method: An external test method in which there is a PCO at the layer boundary at the top of the IUT.

Dynamic Conformance Requirements: All those requirements and

options which determine what observable behavior is permitted by the relevant OSI standards in instances of communication.

Dynamic Interoperability Requirements: All those requirements and options which determine what observable behavior is permitted between peer open systems by compatible standardized profiles of OSI standards, in instances of communication.

Embedded Testing: Testing the behavior of a single layer within a multi-layer IUT without accessing the layer boundaries for that layer within the IUT. (This is contrasted with 'exposed' testing in which the N-service PCO of the IUT is accessible for testing.)

Equivalent Configuration: Any configuration for which conformance is achievable using the same registered test method version used in conformance testing of an implementation under test.

GOSIP Product: A product which implements one or more of the data communications protocols identified in GOSIP and meets the requirements specified herein.

Implementation Under Test (IUT): An implementation of one or more OSI protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing.

Interconnection: Establishment of communication between peer protocol entities over a physical medium or an OSI layer service.

Interoperability Test: An informal test script specified in terms of abstract services, which includes protocol exchange requirements, designed to achieve a specified test purpose.

Interoperability Testing: Testing pairs of compatible, conforming, open systems to demonstrate provision of the application service by each peer.

Means of Testing: The realization of an abstract test method as defined in the OSI Conformance Testing Methodology and Framework. This realization includes the test system, executable test suite, testing support tools (hardware and software) and documentation (including technical test procedures).

Multi-Layer Testing: Testing the behavior of a multi-layer IUT as a whole, rather than testing it layer by layer (in contrast to Single-Layer Testing).

National Voluntary Laboratory Accreditation Program (NVLAP): A

voluntary system for accrediting laboratories found competent to perform specific testing operations. It is part of the National Institute of Standards and Technology Office of Associate Director for Industry and Standards. NVLAP does not confer product or test data certification.

Out-of-band Coordination: A separate communications path used for test coordination procedures which may be realized from a lower-layer service or alternative physical media.

Product Interoperability Test Report: This is a document written at the end of the interoperability testing process, giving the details of the testing carried out for a specific interoperability test suite.

Proficiency Testing: Determination of laboratory testing performance by means of comparison of tests on the same or similar items by two or more laboratories in accordance with predetermined conditions.

Protocol Conformance Test Report (PCTR): A document written at the end of the conformance assessment process, giving the details of the testing carried out for a particular protocol. It includes the identification of the abstract test cases (if these exist) for which corresponding executable test cases were run. It also includes the test purpose(s) and verdict for each test case.

Protocol Implementation Conformance Statement (PICS): A statement made by the supplier of an OSI implementation, or system, stating which capabilities and options have been implemented, for a given OSI protocol.

Protocol Implementation eXtra Information for Testing (PIXIT): A statement made by a supplier or implementor of an IUT which contains or references all of the information (in addition to that given in the PICS) related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT.

Remote Test Method: An external test method in which there is neither a PCO above the IUT nor a standardized test management protocol; some requirements for test coordination procedures may be implied or informally expressed in the abstract test suite but no assumption is made regarding their feasibility or realization.

Single-Layer Testing: Testing the behavior of one layer-protocol from a multi-layer IUT.

Static Conformance Requirements: Constraints which are specified in OSI standards to facilitate interworking by defining the requirements for the capabilities of an implementation.

Static Interoperability Requirements: For potentially interoperable peers these include:

- Compatible static conformance requirements;
- Both systems successfully conformance tested;
- Peers are configured to enable interconnection.

System Conformance Test Report (SCTR): A document written at the end of the conformance assessment process, giving the overall summary of the conformance of the system to the set of protocols for which conformance testing was carried out.

System Under Test (SUT): The real open system in which the IUT resides.

Test System Environment Specification: This is a statement made by a supplier or an implementor of an OSI product which contains or references all of the information (in addition to that given in the PICS) related to the implementation and its environment, which will enable the test parties to execute an appropriate test suite against their implementations.

Verdict: A statement of "Pass", "Fail", or "Inconclusive", specified in the abstract test suite concerning conformance of an IUT with respect to a test case that has been executed.

1.7 Abbreviations

AARE	A_Associate_Response Service Primitive
AARQ	A_Associate_Request Service Primitive
ACSE	Association Control Service Elements
APDU	ACSE Protocol Data Unit
ASN.1	Abstract Syntax Notation One
CLNP	Connectionless Network Protocol
CLNPDU	Connectionless Network Protocol Data Unit
CLNS	Connectionless Network Service
CONS	Connection Oriented Network Service
CP	Presentation Connect PPDU
CPA	Presentation Accept PPDU
CPR	Presentation Reject PPDU
CR	Connect Request TPDU
ES	End System

FIPS	Federal Information Processing Standard
FPDU	File Protocol Data Unit
FTAM	File Transfer Access and Management
GOSIP	Government Open Systems Interconnection Profile
HDLC	High-level Data Link Control
IPMS	Interpersonal Messaging Service
IS	Intermediate System (or International Standard)
LAPB	Link Access Procedure B
LLC	Logical Link Control
MTA	Message Transfer Agent
CSL	Computer Systems Laboratory
NVLAP	National Voluntary Laboratory Accreditation Program
OSI	Open Systems Interconnection
P1	P1 Protocol for Message Transfer Agents
P2	P2 Protocol for Interpersonal Messaging Services
PCO	Point of Control and Observation
PCTR	Protocol Conformance Test Report
PPDU	Presentation Protocol Data Unit
QOS	Quality of Service
RTS	Reliable Transfer Service
SCTR	System Conformance Test Report
TTP	Transport Test Platform
TP0	Transport Protocol Class 0
TP4	Transport Protocol Class 4

1.8 References

National Institute of Standards and Technology (NIST)

1. **Government Open Systems Interconnection Profile (GOSIP)**, Federal Information Processing Standard (FIPS) 146, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.
(This document in turn gives complete references for all of the base standards employed by this FIPS.)

2. **Stable Implementation Agreements for Open Systems Interconnection Protocols, Version No. 1**, December 1987, NIST Special Publication 500-150, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

3. **GOSIP Users Guide**, NIST Special Publication 500-163, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

4. **POSIX: Portable Operating System Interface for Computer Environments**, Federal Information Processing Standard 151-1, U. S. Department of Commerce, National Institute of Standards and Technology, March 1990, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

5. **Computer Protocols Handbook - Operational and Technical Requirements of the Laboratory Accreditation Program for Computer Network Interface Protocol X.25**, National Voluntary Laboratory Accreditation Program, December 1988, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

6. **NVLAP Handbook: Operational Requirements of the Laboratory Accreditation Program for GOSIP Conformance Testing**, National Voluntary Laboratory Accreditation Program, August 1990. National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

7. **Government Open Systems Interconnection Profile (GOSIP) Means of Testing Assessment Handbook**, NCSL/SNA-90/3, August 1990, National Institute of Standards and Technology, National Computer Systems Laboratory, GOSIP Testing Program, Gaithersburg, MD 20899.

8. **Government Open Systems Interconnection Profile (GOSIP) Registration Criteria**, NCSL/SNA-90/4, August 1990, National Institute of Standards and Technology, National Computer Systems Laboratory, GOSIP Testing Program, Gaithersburg, MD, 20899.

9. **Stable Implementation Agreements for Open Systems Interconnection Protocols, Version No. 3**, December 1989, NIST Special Publication 500-177, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

10. **Programming Languages and Database Language SQL VALIDATED PROCESSOR LIST Including GOSIP Conformance Testing Registers**, NISTIR 4500, Quarterly Publication, Ed. Judy B. Kailey, National Institute of Standards and Technology, Computer Systems Laboratory, Software Standards Validation Group, Gaithersburg, MD, 20899.

International Organization for Standardization (ISO)

ISO documents are available from: American National Standards Institute, 1430 Broadway, New York, NY 10018.

1. **OSI Conformance Testing Methodology and Framework**, Parts 1-5, ISO DIS 9646.

2. **General Requirements for the Technical Competence of Testing Laboratories**, ISO/IEC Guide 25, 1982.

3. **Information on Manufacturer's Declaration of Conformity with Standards or other Technical Specification**, ISO/IEC Guide 22, 1982.

4. **X.25 DTE Conformance Testing, Revised text for Data Link Layer Test Suite**, DP8882-2, ISO/IEC JCT 1/SC 6/WG 1 N XXX.

5. **X.25 DTE Conformance Testing, Packet Layer Test Suite**, DP 8882-3, ISO/IEC JCT 1/SC 6/WG 2 N304.

6. **Information Processing - Open Systems Interconnection - Estelle - A formal description technique based on an extended state transition model**, ISO 9074, 1988.

7. **Information Processing Systems - Open Systems Interconnection - LOTOS - A formal description technique based on the temporal ordering of observational behavior**, ISO 8807, 1988.

8. **Information Processing - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1)**, ISO 8824, 1987.

9. **Information Processing - Open Systems Interconnection - Specification of Basic Encoding Rules for ASN.1**, ISO 8825, 1987.

Industrial Technology Institute (ITI)

1. **Test Coverage Analysis and Measurement (TCAM): A Practical Approach to Determining Coverage**, Report No. ITI TR-87-14.1, Industrial Technology Institute, Communications and Network Laboratory, 2901 Hubbard Road, P.O. Box 1485, Ann Arbor, Michigan 48109.

CCITT

1. **SDL**, Recommendation Z.100, 1988, International Telecommunications Union, Place des Nations, CH 1211, Geneva 20 Switzerland.

2. ORGANIZATIONAL MODEL

Conformance and interoperability testing for GOSIP will be accomplished in accordance with the organizational model described in this Clause. This organizational model consists of a Program Sponsor, Accreditation Authority, the NIST OSI Implementors' Workshop, test laboratories and their clients. Each member of this model shares responsibilities for assuring conformance of products to GOSIP. Under the rules and procedures established by NIST CSL, this model will enable a client to have his product tested by any NVLAP accredited test laboratory; and the test results produced by that laboratory accepted by NIST CSL* as the basis for registration as a Conformance Tested GOSIP Product. The registration policy and procedures employed in this organizational model are described in a companion handbook published by NIST CSL [NIST 8].

Full implementation or use of all parts of the organizational model depends on the complexity of the standard(s) and the conformance testing methods applied for the standard(s). In circumstances deemed necessary by the Director of the NIST CSL (or his agent), this report and registers identified by this report may designate alternate or supplementary procedures, means of testing, and abstract test suites for testing GOSIP products.

Table 1 provides a cross-reference of the parties involved in the model, together with their respective roles. The "Clause or Reference" column provides a cross-reference of each role with the respective clause of this report in which such role is described.

Clause or Reference	Role	Responsible Party
2.1	Program Sponsor	Director, NIST CSL
2.1	Program Operator	Agent of the Director of NIST CSL
2.2	Test Laboratory Accreditation Authority	NVLAP
3.	Laboratory Accreditation Procedures	NIST CSL
2.1	Means of Testing Assessment Authority	NIST CSL/Agent
3.2	Means of Testing Assessment Procedures	NIST CSL
Part II	Abstract Test Suite Review and Acceptance	NIST CSL/Public
6.3	Reference Implementation Review and Acceptance	NIST CSL
2.3	Provision of Means of Testing	Test System Suppliers
2.4	Conformance Testing Service	Accredited Conf. Test Laboratory
6.3	Interoperability Test Suite Review and Acceptance	NIST CSL/Public
6.3	Reference Interoperability Testing Service	NIST CSL, Agent, or Conf. Lab
6.3	Multivendor Interoperability Testing	GOSIP Product Suppliers & Users

GOSIP Testing: Organizational Responsibilities

TABLE 1

4.	Abstract Test Suite Registration	Agent of the Director of NIST CSL
4.	Interoperability Test Suite Registration	Agent of the Director of NIST CSL
4.	Reference Implementation Registration	Agent of the Director of NIST CSL
4.	Accredited Test Laboratory Registration	Agent of the Director of NIST CSL
4.	Means of Testing Registration	Agent of the Director of NIST CSL
4.	Conformance Tested Product Registration	Agent of the Director of NIST CSL
4.	Interoperability Tested Product Registration	Interop. Reg. Authority
---	Procurement of GOSIP Products	Acquisition Authority

GOSIP Testing: Organizational Responsibilities
TABLE 1 (continued)

2.1 Program Sponsor

2.1.1 NIST-CSL

The Director of NIST CSL is the Program Sponsor for the GOSIP conformance testing program. The Director of NIST CSL provides the overall direction for organizing, managing, directing, and administering the GOSIP Testing Program.

The Director of NIST CSL has the authority to:

1) Establish and maintain the GOSIP conformance testing program policies and procedures;

2) Register the test methods used in determining conformance of products to GOSIP;

3) Develop and maintain the procedures to be followed by clients of accredited test laboratories in order to attain product registration;

4) Issue a certificate of Registration based on the results of a test report;

5) Establish the accreditation criteria for test laboratories;

6) Maintain and periodically publish a register of products that have passed conformance testing, and a register of products that have passed interoperability testing.

7) Coordinate with other assessment, accreditation and certification authorities for the purpose of harmonizing methods and making provisions for mutual recognition of conformance testing results;

8) Evaluate and resolve disputes on all matters concerning conformance testing for GOSIP;

9) Periodically assess the need for a conformance testing program, maintain test method assessment and test laboratory accreditation programs for GOSIP;

10) Maintain and publish a register of accredited test laboratories recognized by NIST CSL to perform GOSIP conformance testing;

11) Establish the fees or rates for NIST CSL provided products and services; and

12) Announce in the Federal Register and/or the Commerce Business Daily the availability of an assessment service.

2.1.2 Agent of NIST-CSL

The Director of NIST-CSL has the right to designate an Agent, outside of NIST, to be responsible for conducting the program of registration and assessments. Any such designation will be announced in the Federal Register or the Commerce Business Daily.

2.2 GOSIP Accreditation Authority

NVLAP is the Accreditation Authority for GOSIP testing. The role of NVLAP is to inspect and accredit testing laboratories, using the laboratory accreditation procedures provided for GOSIP [NIST 6].

2.3 Suppliers of the Means of Testing

Suppliers undertake to develop and supply to test laboratories the means of testing. Suppliers may be commercial, governmental, educational, or foreign-based organizations.

The responsibilities of a supplier are to:

1) Develop the means of testing for GOSIP protocols in accordance with the criteria specified in this report;

2) Undertake to maintain the means of testing to reflect changes in the published standards and implementors agreements;

3) Obtain and maintain assessment and registration of their product(s);

4) Pay all relevant fees.

2.4 Conformance Test Laboratories

Test laboratories perform conformance testing in accordance with NIST CSL approved procedures. Test laboratories may be commercial laboratories (third-party), vendor laboratories (first-party), university laboratories, Federal, State or local Government laboratories, or foreign-based laboratories.

Only test laboratories accredited under an NIST CSL approved laboratory accreditation program, or test laboratories established as a result of mutual recognition arrangements with NIST CSL or NVLAP shall be recognized by NIST CSL to do GOSIP conformance testing.

The responsibilities of a test laboratory are to:

1) Obtain and maintain laboratory accreditation as appropriate;

2) Conduct conformance testing in accordance with the NIST CSL prescribed procedures;

3) Prepare SCTR and PCTRs in accordance with NIST CSL prescribed procedures as a result of the testing performed;

4) Participate in proficiency testing as required;

5) Pay all relevant fees;

6) Participate in training sessions or meetings as required by NIST CSL to remain up-to-date on changes to the conformance testing procedures;

7) Provide feedback to NIST CSL on problems and improvements relating to the conformance testing procedures;

8) Optionally, to become accredited for, and to conduct, reference interoperability testing.

2.5 Clients

Clients are responsible for submitting requests for product conformance testing to an accredited test laboratory in accordance with testing laboratory prescribed procedures. The responsibilities of a client include:

1) Provide complete and accurate information to the test laboratory for the performance of the requested conformance testing;

2) Unless otherwise agreed to by the test laboratory, provide the test facilities and materials necessary for testing;

3) Provide a product conforming with GOSIP;

4) Provide copies of the PCTR and SCTR to the registration authority, after successful conformance testing by an accredited test laboratory, for the purpose of registration.

2.6 Criteria for NIST CSL* Registration of a Conformant GOSIP Product

1) Submit to NIST CSL* a PICS for a product claiming to conform to GOSIP specifications;

2) Provide Protocol Conformance Test Report(s) and System Conformance Test Report for the product;

3) These reports are to be produced after successful conformance testing by an accredited test laboratory using a registered means of testing, including registered abstract test suites.

4) Pay the appropriate registration fees.

3. ACCREDITATION

NIST CSL* will carry out its responsibilities for conformance testing through test laboratories judged to be competent to objectively perform the necessary tests. Laboratory accreditation serves as a basis for determining laboratory competence. The purpose is to insure that testing facilities are available for obtaining an unbiased assessment of products regarding GOSIP conformance. Clause 3.1 outlines these objectives.

To ensure that test laboratories are using tools which are capable of performing accurate and adequate assessments, NIST CSL defines in clause 3.2 the requirements upon each party involved.

3.1 Test Laboratory Accreditation

Wherever appropriate for a given GOSIP protocol, NIST CSL will draw upon the NIST National Voluntary Laboratory Accreditation Program (NVLAP) as the basis for accrediting test laboratories. NIST CSL shall establish technical criteria for laboratory accreditation. Technical experts for assessing laboratory competence (assessors) may be drawn from qualified Government, academic, industrial, or independent organizations.

The objectives of laboratory accreditation are to:

1) Identify technically competent testing services;

2) Assess and evaluate each test laboratory accredited to do testing for conformance to GOSIP by:

   a) Conducting periodic laboratory proficiency testing to identify testing capability,

   b) Initially, and periodically thereafter, conducting on-site assessments to determine compliance with the accreditation criteria, and

   c) Conducting visits to verify reported changes in the laboratory's personnel, facilities, and operations, or to explore possible reasons for poor performance in testing practices;

3) Insure that the test laboratory has adequate quality control, facilities, equipment and personnel to conduct testing;

4) Determine that the test laboratory staff is adequately trained in using the appropriate registered Means of Testing, following the prescribed conformance testing procedures;

5) Insure that adequate records are maintained to support the testing performed and that test reports are produced to provide the necessary information for determining conformance to GOSIP;

6) Notify the test laboratory of deficiencies;

7) Establish criteria and procedures for test laboratories to both obtain and maintain accreditation.

3.2 Means of Testing Assessment

Prerequisites of the methodology defined below are that an abstract test suite (ATS) exists, standardized or not, which has been publicly reviewed, with respect to the GOSIP PICS, amended as necessary, and is registered by NIST CSL*.

3.2.1 Registered Abstract Test Suites

A recognized abstract test suite shall be registered by the NIST CSL* (hereafter called a registered ATS).

Amendment of an ATS is defined to be:

1) delete test cases which are not applicable to a profile;

2) specify constraints based upon agreements of the OIW which may be made either more rigorous or less rigorous;

3) specify additional test cases as necessary to encompass all mandatory and optional features using criteria stated in Part II of this Report;

4) Registration of the ATS shall be staged to accommodate improvements in the state of the art of test suite development. Each ATS will be harmonized with the ISO work and will reach stability with the International Standard.

3.2.2 Means of Testing Supplier

Suppliers of a Means of Testing shall:

1) Request assessment of a product by submitting the forms and fees as required by the MOT Assessment and Registration Authority;

2) Identify the mapping between each abstract test case and the supplier's realization of it;

3) Arrange for a mutually satisfactory date for assessment of the MOT;

5) Demonstrate to the satisfaction of the MOT Assessment and Registration Authority, that a set of executable test cases corresponding to a set of test cases selected from the registered ATS achieve the test purposes and exhibit the dynamic behavior specified when executed against an implementation of the corresponding OSI protocol;

6) Have a quality management program that assures maintenance and convergence of their product(s) such that the product(s) meet

the requirements of registered ATS(s) and the Means of Testing Assessment and Registration Authority;

7) Have adequate mechanisms for distribution of updates and corrections to test laboratories employing the supplier products, in accordance with NIST CSL staged improvement procedures, and mechanisms to notify test laboratories of known problems in products.

3.2.3 MOT Assessment and Registration Authority

The MOT Assessment and Registration Authority shall:

1) Upon receipt of a request from an MOT supplier, and required fees, arrange for a mutually acceptable date for assessing the product;

2) Select one or more assessors from a group of experts who have no vested interest in the product and are neutral with respect to the results of the assessment, are technically competent with respect to the OSI protocol(s), GOSIP requirements, and the conformance test methodology employed. Assessors may be drawn from the private and public sectors (including agencies of the Federal government) to serve as independent assessors of the product to be accredited;

3) Assess the Means of Testing using either a reference implementation, or an otherwise available implementation of the protocol(s). Tests are selected for execution according to the GOSIP Means of Testing Assessment Handbook [NIST 7].

3.2.4 Role of the MOT Supplier

Using the test cases selected, the supplier shall:

1) provide the assessor with the facility to select and execute test cases on the MOT under assessment;

2) execute test cases selected by the assessor(s);

3) produce log files showing detailed protocol exchange behavior;

4) make these log files available to the assessor(s) for their analysis.

3.2.5 Role of the Assessors

Using the reports, conformance log(s) and the MOT Assessment Handbook, the assessor(s) shall:

1) review the conformance log(s) produced by the product supplier to assure:

   a) the dynamic behaviors identified in the corresponding test cases of the registered ATS are reflected in the conformance log;

   b) verdicts reported in the logs are correct with respect to the verdicts identified in the registered ATS;

2) Directly oversee the execution of a percentage of the tests;

3) If the results of the assessment are affirmative for test cases executed, the assessors shall recommend registration of the MOT.

4) If the initial results of the assessment are negative, then the provisions of the MOT Assessment Handbook shall be followed.

4. REGISTERS EMPLOYED

Essential to the operation of the provisions of this report are registers maintained by NIST CSL*. The names of the registers and a brief description of each are below.

Abstract Test Suites for GOSIP

For each GOSIP protocol a test suite composed of test purposes or abstract test cases is placed in the public domain and designated as the Registered Abstract Test Suite. The tests are updated from time to time to harmonize with International Standard test suites.

Assessed Means of Testing for GOSIP

For GOSIP profiles or substacks, the means of testing are assessed according to the criteria published in a companion handbook [NIST 7]. The treatment of derived implementations of an MOT is described in the same handbook. Any qualified system may be registered for use in GOSIP conformance testing.

Laboratories Accredited for GOSIP Conformance Testing

Any testing laboratory which complies with the provisions of this FIPS and a companion handbook [NIST 6], as administered by the National Voluntary Laboratory Accreditation Program, may be accredited and added to the register. Compliance includes the operation of a registered Means of Testing realizing one or more registered Abstract Test Suites.

Conformance Tested GOSIP Products

GOSIP products which have been successfully tested by an accredited test laboratory using a registered Means of Testing, including registered Abstract Test Suites, may be added to the register. The treatment of derived implementations is described in clause 6.2.3 below. Addition to this register is required before GOSIP interoperability testing is conducted.

Interoperability Test Suites for OSI Products

For each GOSIP application a test suite composed of test purposes is placed in the public domain and designated as the Registered Interoperability Test Suite. The tests are updated from time to time to achieve international harmonization.

Reference Entities for Interoperability Testing

For each GOSIP application or intermediate system and its supporting stack, one implementation which has successfully passed conformance testing and meets the selection criteria specified is designated as the reference entity. Reference entities are used by NIST in the conduct of interoperability testing with OSI product suppliers.

Interworking GOSIP Products

Products which have been successfully tested for interoperability against the NIST CSL* Reference Implementation, by an OSI product supplier over a LAN or WAN, and using NIST CSL* registered Test Suites may be registered.

Interoperability Test and Registration Services

Any organization may offer to define procedures for the conduct of multivendor interoperability testing and to register the results of testing. Any such organization which is approved by NIST is entered onto this meta-register. The number of NIST approved Interoperability Services is not limited. Criteria for NIST approval are given in the GOSIP Registration Criteria handbook [NIST 8].

5. EMPLOYMENT OF THE OSI CONFORMANCE TESTING METHODOLOGY

ISO's OSI Conformance Testing Methodology and Framework [ISO 1] is an evolving multi-part international standard. It defines terminology, concepts, and requirements for: (1) other standards bodies who are responsible for producing abstract test suites; (2) suppliers of a means of testing (real test systems); (3) test laboratories; (4) clients of test laboratories; (5) information exchanged between test laboratories and their clients; and (6) proformas for test reports

(whose content is outlined in Parts 4 and 5 of the ISO Conformance Methodology [ISO 1] and is detailed in standards associated with abstract test suites).

This standard provides the basis for the conformance aspects of the GOSIP testing program; however in certain instances the work of ISO is not applicable to this report. For example, when:

1) Standardized abstract test suites do not exist for a GOSIP protocol,
2) Standardized abstract test suites do not test for features mandated by GOSIP,
3) ISO Conformance methodology does not address:
   a) multi-party or multi-peer protocols,
   b) multi-layer test methods,
   c) physical media, and
4) Interoperability testing is required.

The means of testing employed by accredited test laboratories may be a product of either the public sector or private sector, if the latter is a commercially available product.

In general, this report references abstract test suites (or test methodology) for GOSIP which are based on the NIST OSI Implementors' Workshop Agreements [NIST 2, NIST 9]. They may be produced by the public sector, including standards bodies, or the private sector. Any registered abstract test suite or other test methodology employed shall be in the public domain, without protection of copyright.

This report provides criteria for assessment of the coverage and quality of test suites. As standardized abstract test suites, and their derived executable test suites, become available, they will be assessed for their adequacy under the criteria in this report, in order that they may be approved for use in testing GOSIP products.

Staged improvements to the abstract test suites will be conducted in accordance with the GOSIP registration criteria [NIST 8]. The intention is ultimately to harmonize with International Standard OSI test suites.

6. TESTING FRAMEWORK

6.1 Relation Between Testing Phases

The immediate goal of testing communications products which claim to conform to the GOSIP specifications is to qualify them for inclusion in either the Register of Conformance Tested GOSIP Products, the Register of Interworking GOSIP Products, or both. The phases of testing coinciding with registration are conformance testing and interoperability testing, respectively.

1) Successful conformance testing by an accredited test laboratory using a registered Means of Testing, including registered Abstract Test Suites, leads to addition to the Register of Conformance Tested GOSIP Products.

2) Successful interoperability testing against a Registered Reference Entity, leads to addition to the Register of Interworking GOSIP Products.

3) Successful interoperability testing with other compatible products using a recognized methodology, that is, one on the Register of Interoperability Test and Registration Services, leads to publicly accessible documentation of pair-wise multi-vendor interoperability.

Requirements for GOSIP product suppliers to enter each phase of testing follow.

Conformance

1) Develop a GOSIP conformant product, or a partial stack thereof, which is testable using at least one of the methods specified in this report.

2) Provide a PICS to an accredited test laboratory specifying functionality supported in the implementation for each protocol in the stack.

3) Provide a PIXIT to the accredited test laboratory for the stack/substack.

4) For stacks which build on substacks which have been previously conformance tested within the GOSIP testing process, provide an SCTR, PCTR and evidence of Registration for the previously tested functionality. For instance if the session protocol is to be tested over transport class 4 protocol (TP4), an SCTR, PCTR and certificate of registration should be furnished for the TP4 substack, as evidence that all the supporting protocols do not need to be completely retested.

Interoperability Testing

Entry on the NIST CSL* register of conforming GOSIP products is a prerequisite to GOSIP interoperability testing. Interoperability testing against the NIST CSL* Reference Implementation occurs if and only if a reference implementation is registered for a specific protocol or stack. There is no procedural distinction drawn between interoperability testing against the NIST CSL* reference and pairwise GOSIP product supplier interoperability testing.

Detailed mechanisms applicable to conformance and interoperability testing and the assessment thereof, are given in the following clauses.

6.2 Conformance Testing

6.2.1 What Is To Be Tested

Products of the following types may be made available for conformance testing:

- 7 layer Application stacks,
- 7 layer Relay stacks,
- 4 layer transport stacks,
- 2 or 3 layer Network stacks,
- 3 layer Intermediate System stacks.

This structuring explicitly recognizes test platforms (substacks) employed by existing testing technology.

In conformance testing, previously tested End System substacks may be carried forward into larger substacks. In such cases, comprehensive retesting of previously tested functionality is not necessary: Basic Interconnection Testing is sufficient, providing that Protocol Conformance Test Reports are furnished for previously tested protocols. However, the same principle does not work in reverse. If a 7 layer stack is tested, using Single-layer embedded methods for the lower layers, and a substack is subsequently extracted and added as a component of a different 7 layer stack, then the whole of the new stack shall be comprehensively tested. This is because embedded testing alone does not provide sufficient confidence in a lower layer protocol when considered outside of its original stack context.

The complete set of full stack profile possibilities for GOSIP 1.0 is given in Part II, clause 1.5. To take as an example stack number 1.

FTAM/ACSE/Presentation/Session/TP4/CLNP/LLC1/8802.3

Conformance testing of substacks may proceed as follows.

1) The subnetwork protocols (LLC1/8802.3) may be tested (although this is not separately mandated) and a System Conformance Test Report (SCTR) is produced.

2) TP4/CLNP is offered for testing over 802.3; the SCTR is provided to demonstrate conformance to 8802.3. Basic interconnection testing is conducted to establish the basic workability of the substack. CLNP is tested by coordinated single-layer embedded

means; TP4 is tested by coordinated single layer means. If conformance to both protocols is established, a second SCTR is produced for the substack.

3) FTAM is offered for testing over TP4; the second SCTR is provided to demonstrate conformance to TP4, CLNP and 8802.3. Basic interconnection testing is conducted to establish the basic workability of the stack (as an FTAM Initiator or as an FTAM Responder). Session, presentation and ACSE are tested by remote single-layer embedded means for use with FTAM Responders, and by distributed single-layer embedded means for use with FTAM Initiators. An FTAM Responder is tested by remote single-layer means; an FTAM Initiator is tested by distributed single-layer means. If conformance to all protocols is established, an SCTR is produced for the FTAM Initiator and Responder stacks.

If it is subsequently desired to test X.400 in stack 8 (Part II, Clause 1.5) then the SCTR may be taken from step 2) above, as proof of conformance of TP4/CLNP/LLC1/8802.3. Basic interconnection testing is performed to establish the basic workability of the stack. The session, RTS and P1 protocols are tested by distributed single-layer embedded means. The P2 protocol is tested by distributed single-layer means. If conformance is established, an SCTR is issued for the MHS End System stack.

6.2.2 How Testing Is Conducted

These GOSIP Testing Guidelines are guided by the recommendations given in the OSI Conformance Testing Methodology and Framework [ISO 1]. MOT suppliers and conformance test laboratories are expected to be familiar with Part 5 which provides Requirements on Test Laboratories and Clients for the Conformance Assessment Process, and with the General Principles and Abstract Test Methods defined in Parts 1 and 2.

6.2.2.1 Testing Elements

For each stack supplied, the product configuration determines the test method used. Part 1 defines Abstract Test Methods which may be employed and provides guidance on their applicability to real test systems. Central to the concept of conformance testing is the ability to control and observe events of the Implementation Under Test (IUT) within the System Under Test (SUT). Every test method has, at minimum, a Point of Control and Observation (PCO) through the medium which connects the means of testing with the SUT. This is the point at which the means of testing injects valid and invalid Protocol Data Units (PDUs) of the protocol or protocols under test, and observes PDUs returned from the SUT. Any SUT which is accessible only through this PCO is testable using the Remote method. The distributed and coordinated methods provide extra control and coordination with the SUT, and this is usually effected through test

coordination procedures which exist between the means of testing and the SUT. In all cases the initial stimulus for testing comes from the means of testing. For the remote method, the SUT is stimulated by protocol data units received via an underlying OSI service. For the distributed method, the SUT is stimulated directly at the (N) service, by coordination interactions between the Means of Testing and the SUT. For the coordinated method the SUT is stimulated to generate (N)-PDUs as a result of prior interactions between the lower tester and upper tester, by means of a test management protocol. The set of acceptable Abstract Test Methods for specific protocols in the GOSIP profile is given in Part II of this report.

The OSI Conformance Testing Methodology and Framework structures a test suite into Basic Interconnection, Capability and Behavior tests. The first two of these categories are proper subsets of the third (although the test purposes may be different). In the limit, Behavior tests provide exhaustive coverage - a limit which is by no means practical. Basic Interconnection tests are used in practical testing situations to check out the basic operation of the linkage between the SUT and the means of testing, and as such are not mandatory for coverage purposes. Capability tests are intended to provide 100 per cent 'breadth' of test coverage, i.e., at least one test per function specified in the protocol/NIST Implementor's Agreements for all mandatory and optional features. Behavior tests provide extra depth of coverage over all of the capabilities. In regard to coverage, options in a protocol are not optional in a test suite. Tests must be available for each option, even though they may not be selected for use with a particular IUT.

The administration of GOSIP testing includes recognition and registration of abstract test suites for each GOSIP protocol. Specific provisions are given in the GOSIP Means of Testing Assessment Handbook [NIST 7].

6.2.2.2 The Process

The conformance assessment process includes:

- Preparation for testing,
- Test operations,
- Test report production.

The following clauses provide a brief description of these phases. A comprehensive description is given in Part 5 of IS 9646. Accreditation of conformance testing laboratories is directly based on the use of that test methodology.

6.2.2.3 Preparation For Testing

The preparation phase defines general documentation and configuration

steps which must be carried out prior to conducting a test campaign. This includes furnishing of GOSIP PICS, PIXIT, and any vendor configuration requirements to a test laboratory.

6.2.2.4 Test Operations

The test operations phase includes static conformance assessment, test selection and parameterization, followed by dynamic testing. Test selection is based on options claimed to be supported in the IUT, as documented in the GOSIP PICS. Parameterization of selected tests is based on information provided in the PIXIT. Dynamic testing occurs using the executable realization of the selected abstract test cases, in which each test case is executed against the IUT to produce a Verdict. Any 'Inconclusive' verdicts may be resolved into 'Pass' or 'Fail' at this time.

6.2.2.5 Test Report Production

Test report production is a phase of assessment of the results of dynamic testing, and production of System Conformance Test Report and Protocol Conformance Test Report(s), recording the verdicts determined during the dynamic assessment.

6.2.2.6 Addressing

The testing of addressing includes a static check against the PIXIT for employment of the GOSIP addressing structure, and Basic Interconnection Tests to ensure that addressing is accurate.

6.2.2.7 Evaluation of Conformance Testing

Detailed criteria for the evaluation of conformance testing are provided by the GOSIP Means of Testing Assessment Handbook [NIST 7], for test systems; and the NVLAP Handbook: Operational Requirements of the Laboratory Accreditation Program for GOSIP Conformance Testing [NIST 6], for conformance testing laboratories.

6.2.3 Treatment of Derived Products

In certain circumstances a GOSIP Means of Testing or a GOSIP Product may be derived from a tested 'base' implementation, without requiring further formal testing. The following conditions must hold:

(a) The registration date for the base implementation has an expiration date at least six months beyond the date of derivation.

(b) The host and target computer systems of the base and derived GOSIP Implementations have compatible instruction sets and operating systems. Common examples of compatible instruction

sets and operating systems are two different computer system models in a manufacturer's product line or the computer systems produced by different manufacturers that use the same hardware mechanisms and operating systems.

(c) The GOSIP MOT or Implementation proposed for registration was derived from the base implementation by changes that are within the scope of accepted software maintenance practices. Arguments along this line should be included, in writing, with the application.

(d) The PCTR and SCTR for the GOSIP Implementation are either the same as the base implementation or, if there are minor differences, these differences are justified as being within the scope of accepted software maintenance practices.

(e) The base implementation was assessed in accordance with NIST CSL* procedures and is registered with the NIST CSL*.

A derived implementation may lose its registration if it is challenged successfully. Such challenges are described in the 'Appeals' section of the GOSIP Registration Criteria [NIST 8].

6.3 Interoperability Testing

At present, no authoritative national or international forum for interoperability testing has emerged. Consequently there is no widely accepted consensus on methods or results, and no authoritative references on the conduct of interoperability testing. As and when such an authoritative consensus emerges NIST CSL intends to harmonize with accepted methods. For the time being the following clauses define NIST CSL requirements for interoperability testing systems.

6.3.1 What Is Tested

Products made available for interoperability testing may be:

- 7 layer Application stacks,
- 7 layer Application Relay stacks,
- 3 layer Intermediate System stacks.

In the case of End Systems, interoperability testing proceeds by pairwise operation of compatible GOSIP systems. For instance, supplier A wishing to test an FTAM Initiator against supplier B should ensure first that B's product provides FTAM Responder capability with a compatible GOSIP profile. Moreover if B provides sender only, then A must be capable of receiving. It is for this reason that, in the same way as with conformance testing, a static analysis phase is necessary to determine whether testing can proceed at all.

Interoperability testing with Intermediate Systems (IS) operates on a multi-peer basis; pairs of End Systems communicate through one or more 3 layer Intermediate Systems. An IS must be capable of working with each End System on each supported subnetwork, and of routing data between pairs of End Systems. In a complex concatenated network, an IS must also route data from and to other ISs. Interoperability testing with Message Transfer Agent relay entities proceeds in a similar manner to Intermediate System testing, on a multi-peer basis.

6.3.2 How Testing Is Conducted

The interoperability testing requirements of U.S. GOSIP are grounded in the use of the following registers:

- the Register of GOSIP Reference Implementations
- the Register of Interoperability Test Suites
- the Register of Interoperability Testing Services
- the Register of Interoperating GOSIP products

6.3.2.1 Requirements of an Interoperability Testing Suite

In order to be entered onto the register, an Interoperability Test Suite must:

1) be freely available in the public domain without copyright protection,

2) be subject to public review,

3) be capable of exercising the mandatory and optional services of each GOSIP application,

4) describe the purpose of each test and procedures by which the test purpose can be realized,

5) specify what constitutes a 'pass' or 'successful execution' for each test, and,

6) be supported by an organization recognized by NIST CSL.

For each GOSIP application, only one Interoperability Test Suite may be registered. When a Test Suite becomes qualified it will be provisionally registered until the next GOSIP Version release. It will be reviewed and updated at that time. Staged improvements leading to harmonization proceed in this way until the completed Test Suite is fully registered. Registration remains current while the Implementation Agreements or the base standards remain valid. If more than one valid Interoperability Test Suite becomes available for

a particular application stack, then one only will be selected by NIST CSL* for registration.

6.3.2.2 Requirements of an Interoperability Testing Service

In the same way as with Conformance Testing, Interoperability Testing can be characterized as having the three phases of preparation, test operations and test report production. In order to become registered, any forum seeking to offer an Interoperability Testing Service must meet the following criteria:

1) Be an organization recognized by NIST CSL.

2) Use a registered Interoperability Test Suite.

3) Arrange for a bilateral agreement to test between each pair of GOSIP product suppliers (or multilateral in the case of Intermediate Systems testing).

4) Conduct a static analysis phase which involves the selection of a common subset of the GOSIP tests including all of the mandatory tests.

5) Conduct a dynamic analysis phase in which both GOSIP product suppliers are in agreement concerning the outcome of each test. At the discretion of one or more of the GOSIP product suppliers, an Interoperability Testing campaign may be terminated before the Test Report is produced.

6) Issue a test report which identifies each GOSIP product supplier, describes the product including the supporting stack of protocols, and provides a list of the tests executed with a verdict for each test. The verdict may be 'pass' or 'fail'. Any fail verdict must be accompanied by an explanation outlining the cause of failure.

7) At the request of NIST CSL*, a copy of the test report resulting from any bilateral or multilateral agreement made under the auspices of the Interoperability Testing Service. A nominal fee may be charged for each report supplied. Each GOSIP product supplier may require limitations on the use for which a test report is employed.

In cases where Federal Government Agencies find a persistent lack of interoperability among products registered as interoperable, appeals may be made as follows:

1) To the vendor, or vendors of the inoperable products, who shall make every effort to make good on their warranty.

2) To the Interoperability Test and Registration Service who, after investigation may remove the product pair from the register.

3) To NIST CSL* who may require to witness testing of either or both of the products involved, under the auspices of the Interoperability Test and Registration Service, in the original pairing, or in any other pairings required by NIST CSL*. In the event that NIST CSL* and the procuring Agency remain unsatisfied then the Interoperability Test and Registration Service may have its registration revoked.

6.3.3 Treatment of Derived Implementations

For the purpose of interoperability testing, no distinction shall be made for derived implementations. Any product registered should be subject to pairwise testing.

6.4 Criteria for Registration as a Reference Entity

NIST shall maintain a register of reference entities with which interoperability testing is mandated. If no reference entity is registered, then no interoperability testing for a GOSIP protocol is mandated. Criteria for inclusion in this register follow. The criteria for inclusion are presented in a ranked order. Specifically, the first criterion is more important than subsequent criteria; if alternatives are identified, then the first alternative is more important than subsequent alternatives (e.g., 1.b or 1.c).

1) Profile Implemented:
   a) shall implement all mandatory features; and
   b) all optional features specified in GOSIP; or
   c) an identified subset of optional features specified in GOSIP.

2) GOSIP Testing:
   a) Conformance: shall pass all conformance tests for mandatory and optional features implemented; and
   b) Interoperability: shall have demonstrated interoperability with at least three suppliers implementations of GOSIP products.

3) Availability:
   a) shall be in the public domain; or
   b) shall be publicly available to all potential users and interested parties (not unduly restricted from use by manufacturers, academia, Government, or other users due to legal considerations, license constraints or cost).

If an implementation is available which is deficient in some of the above requirements, then at the option of NIST CSL* it may be

provisionally registered. Provisionally registered Reference Implementations shall be restricted to use for dynamic evaluation of candidate MOTs for GOSIP Conformance Testing.

7. RECOGNITION OF OTHER CONFORMANCE TESTING ACTIVITIES

NIST seeks to provide economical and adequate conformance testing. It is not the intent of NIST to duplicate conformance testing activities where those activities meet Federal requirements. Thus, NIST CSL will coordinate with other organizations to harmonize conformance testing requirements.

In meeting these objectives, NIST CSL will consider the use of existing test methods, conformance testing procedures, test laboratories and certification systems.

Possible recognition of other activities include:

1) Foreign-based test laboratory accreditation and services,

2) Test method administration (maintenance and distribution systems),

3) Conformance testing procedures,

4) Test reports,

5) Certificates, and

6) Test method research and development.

NIST may use any of the following methods for formally recognizing the conformance testing activities of other organizations:

1) Contract,

2) Accreditation,

3) Memorandum of Understanding, or

4) International Standard.

Any of the above methods are acceptable if they do not conflict with or compromise NIST's authority in carrying out its responsibilities or violate Federal regulations.

Unless otherwise approved by the Director of NIST CSL, agreements concerning conformance testing shall not:

1) Grant exclusive rights to others in fulfilling its responsibilities in the areas described above.

2) Unilaterally agree to adopt a product or service which conflicts with, or that does not allow for changes to meet, NIST CSL requirements.

GOSIP CONFORMANCE AND INTEROPERATION TESTING AND REGISTRATION

PART II: TECHNICAL CRITERIA FOR GOSIP VERSION 1.0

1. INTRODUCTION

This report provides the overall procedures for the operation of the GOSIP testing and registration program, and specific technical criteria pertaining to GOSIP protocols and profiles. Consequently this report is organized into separate but related parts: Part I provides the overall policy and operational criteria and is applicable to all future versions of GOSIP; This part, Part II provides the technical criteria for the protocols and profiles specified in GOSIP Version 1.0.

1.1 Definitions

Abstract Test Case: A complete and independent specification of the actions required to achieve a specific test purpose (or a specified combination of test purposes), defined at the level of abstraction of a particular abstract test method. It may include a preamble and postamble to ensure starting and ending in a stable state (i.e. an identifiable stable state of the SUT which can be easily reached and maintained, such as the 'idle' state or the 'data transfer' state). This specification may involve one or more consecutive or concurrent connections.

Abstract Test Method: The description of how an IUT is to be tested, given at an appropriate level of abstraction to make the description independent of any particular implementation of testing tools, but with enough detail to enable tests to be specified for this test method.

Basic Interconnection Tests: Limited tests of an Implementation Under Test (IUT) to determine whether or not there is sufficient conformance to the relevant protocol(s) for interconnection to be possible, without trying to perform thorough testing.

Behavior Tests: Tests to determine the extent to which the dynamic conformance requirements are met by the IUT.

Capability Tests: Tests to determine the capabilities of an IUT. (Note, this involves checking all mandatory capabilities and those optional ones that are stated in the Protocol Implementation Conformance Statement (PICS) as supported, but not checking those optional ones which are stated in the PICS as not supported by the IUT.)

Conformance: Fulfillment by a product of all requirements specified.

Conformance Testing: Testing the extent to which an IUT is a conforming implementation.

Coordinated Test Method: An external test method for which a standardized test management protocol is defined as the test coordination procedures, enabling the control and observation to be specified solely in terms of the lower tester activity, including the control and observation of test management PDUs.

Distributed Test Method: An external test method in which there is a PCO at the layer boundary at the top of the IUT.

Dynamic Conformance Requirements: All those requirements and options which determine what observable behavior is permitted by the relevant OSI standards in instances of communication.

Embedded Testing: Testing the behavior of a single layer within a multi-layer IUT without accessing the layer boundaries for that layer within the IUT. (This is contrasted with 'exposed' testing in which the N-service PCO of the IUT is accessible for testing.)

GOSIP Product: A product which implements one or more of the data communications protocols identified in GOSIP and meets the requirements specified herein.

Implementation Under Test (IUT): An implementation of one or more OSI protocols in an adjacent user/provider relationship, being that part of a real open system which is to be studied by testing.

Means of Testing: The realization of an abstract test method as defined in the OSI Conformance Testing Methodology and Framework. This realization includes the test system, executable test suite, testing support tools (hardware and software) and documentation (including technical test procedures).

Multi-Layer Testing: Testing the behavior of a multi-layer IUT as a whole, rather than testing it layer by layer (in contrast to Single-Layer Testing).

Out-of-band Coordination: A separate communications path used for test coordination procedures which may be realized from a lower-layer service or alternative physical media.

Protocol Conformance Test Report (PCTR): A document written at the end of the conformance assessment process, giving the details of the testing carried out for a particular protocol. It includes the identification of the abstract test cases (if these exist) for which corresponding executable test cases were run. It also includes the test purpose(s) and verdict for each test case.

Protocol Implementation Conformance Statement (PICS): A statement made by the supplier of an OSI implementation, or system, stating which capabilities and options have been implemented, for a given OSI protocol.

Protocol Implementation eXtra Information for Testing (PIXIT): A statement made by a supplier or implementor of an IUT which contains or references all of the information (in addition to that given in the PICS) related to the IUT and its testing environment, which will enable the test laboratory to run an appropriate test suite against the IUT.

Remote Test Method: An external test method in which there is neither a PCO above the IUT nor a standardized test management protocol; some requirements for test coordination procedures may be implied or informally expressed in the abstract test suite but no assumption is made regarding their feasibility or realization.

Static Conformance Requirements: Constraints which are specified in OSI standards to facilitate interworking by defining the requirements for the capabilities of an implementation.

System Conformance Test Report (SCTR): A document written at the end of the conformance assessment process, giving the overall summary of the conformance of the system to the set of protocols for which conformance testing was carried out.

System Under Test (SUT): The real open system in which the IUT resides.

Test Management Protocol (TMP): A protocol which is used to implement the test coordination procedures for a particular test suite.

Transverse Test Method: Used for testing a relay system from two subnetworks, in this test method there are 2 PCOs, one on each subnetwork, at SAPs external from the N-relay.

Verdict: A statement of "Pass", "Fail", or "Inconclusive", specified in the abstract test suite concerning conformance of an IUT with respect to a test case that has been executed.

1.2 Abbreviations

AARE	A_Associate_Response Service Primitive
AARQ	A_Associate_Request Service Primitive
ACSE	Association Control Service Elements
APDU	ACSE Protocol Data Unit
ASN.1	Abstract Syntax Notation One
CLNP	Connectionless Network Protocol
CLNPDU	Connectionless Network Protocol Data Unit
CLNS	Connectionless Network Service
CONS	Connection Oriented Network Service
CP	Presentation Connect PPDU
CPA	Presentation Accept PPDU
CPR	Presentation Reject PPDU
CR	Connect Request TPDU

ES	End System
FIPS	Federal Information Processing Standard
FPDU	File Protocol Data Unit
FTAM	File Transfer Access and Management
GOSIP	Government Open Systems Interconnection Profile
HDLC	High-level Data Link Control
IPMS	Interpersonal Messaging Service
IS	Intermediate System (or International Standard)
LAPB	Link Access Protocol B
LLC	Logical Link Control
MTA	Message Transfer Agent
CSL	Computer Systems Laboratory
NVLAP	National Voluntary Laboratory Accreditation Program
OSI	Open Systems Interconnection
P1	P1 Protocol for Message Transfer Agents
P2	P2 Protocol for Interpersonal Messaging Services
PCO	Point of Control and Observation
PCTR	Protocol Conformance Test Report
PPDU	Presentation Protocol Data Unit
QOS	Quality of Service
RTS	Reliable Transfer Service
SCTR	System Conformance Test Report
TTP	Transport Test Platform
TP0	Transport Protocol Class 0
TP4	Transport Protocol Class 4

1.3 References

National Institute of Standards and Technology (NIST)

1. **Government Open Systems Interconnection Profile (GOSIP)**, Federal Information Processing Standard (FIPS) 146, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.
(This document in turn gives complete references for all of the base standards employed by this FIPS.)

2. **Stable Implementation Agreements for Open Systems Interconnection Protocols, Version No. 1**, December 1987, NIST Special Publication 500-150, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

3. **GOSIP Users Guide**, NIST Special Publication 500-163, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

4. **POSIX: Portable Operating System Interface for Computer Environments**, Federal Information Processing Standard 151, U. S. Department of Commerce, National Institute of Standards and Technology, September 1988, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

5. **Computer Protocols Handbook - Operational and Technical Requirements of the Laboratory Accreditation Program for Computer Network Interface Protocol X.25**, National Voluntary Laboratory Accreditation Program, December 1988, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

6. **Operational Requirements of the Laboratory Accreditation Program for GOSIP Conformance Testing**, National Voluntary Laboratory Accreditation Program, August 1990. National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

7. **Government Open Systems Interconnection Profile (GOSIP) Means of Testing Assessment Handbook**, NCSL/SNA-90/3, August 1990, National Institute of Standards and Technology, National Computer Systems Laboratory, GOSIP Testing Program, Gaithersburg, MD 20899.

8. **Government Open Systems Interconnection Profile (GOSIP) Registration Criteria**, NCSL/SNA-90/4, August 1990, National Institute of Standards and Technology, National Computer Systems Laboratory, GOSIP Testing Program, Gaithersburg, MD, 20899.

9. Stable Implementation Agreements for Open Systems Interconnection Protocols, Version No. 1, December 1989, NIST Special Publication 500-177, National Technical Information Service, U. S. Department of Commerce, 5285 Port Royal Road, Springfield, Virginia 22161.

International Organization for Standardization (ISO)

ISO documents are available from: American National Standards Institute, 1430 Broadway, New York, NY 10018.

1. OSI Conformance Testing Methodology and Framework, Parts 1-5, ISO DIS 9646.

2. General Requirements for the Technical Competence of Testing Laboratories, ISO/IEC Guide 25, 1982.

3. Information on Manufacturer's Declaration of Conformity with Standards or other Technical Specification, ISO/IEC Guide 22, 1982.

4. X.25 DTE Conformance Testing, Data Link Layer Test Suite, DIS 8882-2, 1990.

5. X.25 DTE Conformance Testing, Packet Layer Test Suite, IS 8882-3, 1990.

6. Information Processing - Open Systems Interconnection - Estelle - A formal description technique based on an extended state transition model, ISO 9074, 1988.

7. Information Processing Systems - Open Systems Interconnection - LOTOS - A formal description technique based on the temporal ordering of observational behavior, ISO 8807, 1988.

8. Information Processing - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1), ISO 8824, 1987.

9. Information Processing - Open Systems Interconnection - Specification of Basic Encoding Rules for ASN.1, ISO 8825, 1987.

Industrial Technology Institute (ITI)

1. Test Coverage Analysis and Measurement (TCAM): A Practical Approach to Determining Coverage, Report No. ITI TR-87-14.1, Industrial Technology Institute, Communications and Network Laboratory, 2901 Hubbard Road, P.O. Box 1485, Ann Arbor, Michigan 48109.

CCITT

1. SDL, Recommendation Z.100, 1988, International Telecommunications Union, Place des Nations, CH 1211, Geneva 20 Switzerland.

1.4 Organization of Part II

This part of the report lists the 3- and 7- layer profiles of GOSIP version 1.0 and describes the technical criteria for Means of Testing necessary for each GOSIP protocol, separated into Supporting Protocol Criteria (layers 1 through 6), and Application Protocol Criteria (layer 7). The final clause provides the GOSIP compliance schedule for version 1.0 protocols.

1.5 Applicable GOSIP Profiles

Below is a list of profiles from GOSIP version 1.0 which are the basis for selection of substacks for testing.

<u>End System Profiles</u>

1 FTAM/ACSE/Presentation/Session/TP4/CLNP/LLC1/8802.3
2 FTAM/ACSE/Presentation/Session/TP4/CLNP/LLC1/8802.4
3 FTAM/ACSE/Presentation/Session/TP4/CLNP/LLC1/8802.5
4 FTAM/ACSE/Presentation/Session/TP4/CLNP/X.25/HDLC/V.35
5 FTAM/ACSE/Presentation/Session/TP4/CLNP/X.25/HDLC/RS232C
6 FTAM/ACSE/Presentation/Session/TP4/X.25/HDLC/V.35
7 FTAM/ACSE/Presentation/Session/TP4/X.25/HDLC/RS232C
8 X.400/Session/TP4/CLNP/LLC1/8802.3
9 X.400/Session/TP4/CLNP/LLC1/8802.4
10 X.400/Session/TP4/CLNP/LLC1/8802.5
11 X.400/Session/TP4/CLNP/X.25/HDLC/V.35
12 X.400/Session/TP4/CLNP/X.25/HDLC/RS232C
13 X.400/Session/TP4/X.25/HDLC/V.35
14 X.400/Session/TP4/X.25/HDLC/RS232C
15 X.400/Session/TP0/X.25/HDLC/V.35
16 X.400/Session/TP0/X.25/HDLC/RS232C

<u>Seven Layer Relay Profiles</u>

17 X.400/Session/TP4/CLNP/LLC1/8802.3
18 X.400/Session/TP4/CLNP/LLC1/8802.4
19 X.400/Session/TP4/CLNP/LLC1/8802.5
20 X.400/Session/TP4/CLNP/X.25/HDLC/V.35
21 X.400/Session/TP4/CLNP/X.25/HDLC/RS232C
22 X.400/Session/TP4/X.25/HDLC/V.35
23 X.400/Session/TP4/X.25/HDLC/RS232C
24 X.400/Session/TP0/X.25/HDLC/V.35
25 X.400/Session/TP0/X.25/HDLC/RS232C

Three Layer Relay Profiles

17 CLNP/LLC1/8802.3
18 CLNP/LLC1/8802.4
19 CLNP/LLC1/8802.5
20 CLNP/X.25/HDLC/V.35
21 CLNP/X.25/HDLC/RS232C

The possible Transport Test Platforms of the specified GOSIP protocols are separately identified below: the first seven employ class 4 and the latter two employ class 0.

Transport Platforms

22 TP4/CLNP/LLC1/8802.3
23 TP4/CLNP/LLC1/8802.4
24 TP4/CLNP/LLC1/8802.5
25 TP4/CLNP/X.25/HDLC/V.35
26 TP4/CLNP/X.25/HDLC/RS232C
27 TP4/X.25/HDLC/V.35
28 TP4/X.25/HDLC/RS232C
29 TP0/X.25/HDLC/V.35
30 TP0/X.25/HDLC/RS232C

In order for an OSI product supplier to claim 7-layer GOSIP Version 1.0 compliance or conformance these are the only possible combinations. Subject to Agency requirements, alternative Link and Physical media may be supplied. In such cases it must be made clear by the product supplier which products, or aspects of a multi-layered product, to which GOSIP compliance or conformance is or is not applicable.

2. SUPPORTING PROFILE TESTING CONSTRAINTS

Profiles for the supporting layers and including the presentation layer are presented in this clause and subclauses identify specific test methods and their associated test suite constraints for individual protocols and for profiles within GOSIP.

Clause 3 provides Application profile testing constraints. Functional requirements for testing implementations of each protocol are specified within the contexts in which they are commonly packaged. An Acquisition Authority may require a different packaging for certain GOSIP protocol combinations. In such cases, separate functional requirements for conformance test systems may need to be developed which are compatible with the requirements as stated herein. This Clause seeks to address major functional requirements of a means of testing and abstract test suite for each protocol within GOSIP.

There is some overlap between criteria specified in Clauses 2 and 3

for the means of testing and test suite coverage. This overlap eliminates forward and backward references, and identifies the different roles of protocols within profiles in this clause and the next. This self-contained completeness of specifications provides ease of reference in evaluation of the means of testing in their different protocol testing roles.

The abstract test methods specified in defining the testing requirements for each GOSIP protocol are drawn from Part 2 of the OSI Conformance Testing Methodology and Framework [ISO 1]. These definitions are duplicated in 1.1 above.

In addition, these basic concepts are constructive: for instance the term **distributed single-layer embedded testing** is an aggregation of the basic methods defined above.

2.1 General Characteristics

To reduce the redundancy in this Clause and the next, within each protocol clause, the common characteristics are placed here in this clause and referenced in each subclause entitled "Characteristics of the Means of Testing".

Common Characteristics of the Means of Testing

1) The capability to analyze PICS and PIXIT for the IUT and to select and parameterize tests to be run, and to configure the means of testing for communication with the SUT.

2) Procedures to reconcile PDU and test data with the test purposes and yield a verdict for each test purpose.

3) The capability to produce Conformance Test Reports, listing test cases executed and their verdicts, and detailing the IUT behavior in cases of failure.

4) Capability to record the protocol data units exchanged with the IUT in a conformance log, and to review the structure and encoding of protocol data units after the test campaign is complete.

2.2 Physical

FIPS 146 GOSIP does not specify any particular physical layer protcols or characteristics. Consequently, no particular testing requirements are employed in this testing specification, except insofar as physical layer media shall implicitly provide communications capability when testing or operating link through application protocols in GOSIP stacks.

2.3 Link

The link layer protocol implementations are often based on the combination of the integrated circuits and supplementary controlling circuits. The conformance of a particular implementation and the interoperability of the implementation with other implementation are not guaranteed by the use of a 'good chip'. Conformance testing needs to be carried out for every implementation regardless of its components or internal design in order to ensure that the implementation conforms to the standard and therefore has the potential for interoperability with other implementations.

2.3.1 HDLC (LAPB)

2.3.1.1 Configuration of the Means of Testing

Conformance testing of HDLC (LAPB) DTEs is conducted in conjunction with the X.25 packet layer protocol over tested physical media. The following configurations apply.

X.25/HDLC(LAPB)/RS232C
X.25/HDLC(LAPB)/V.35

The test method used for HDLC(LAPB) testing shall be the remote single-layer embedded method.

2.3.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in 2.1 above.

1) The capability to construct HDLC link frames and send them to the DTE under test over the physical medium.

2) The capability to receive and decode HDLC link frames according to IS 7776. The capability to validate HDLC frames and record the results in a conformance log.

3) The capability to construct valid as well as invalid HDLC frames.

4) The capability to monitor and to initiate HDLC link frame exchanges with the SUT and to record the results.

2.3.1.3 Test Suite Coverage

The tests used shall be those specified in the X.25 DTE conformance testing - Data Link Layer Test Suite [ISO 4].

2.3.2. 8802-2 (LLC) Type 1

2.3.2.1. Configuration of the Means of Testing

Conformance testing of 8802-2 (LLC) type 1 operation is conducted over tested MAC and physical layer and media. The following station configurations are possible.

8802-2/8802-3
8802-2/8802-4
8802-2/8802-5

The above configuration operates in the contexts of Relay Profiles or Transport Platform Profiles.

The testing method for the 8802-2 type 1 is remote embedded. The means of testing contains a physical and MAC layer implementation necessary to exchange LLC frames with these stations.

2.3.2.2. Characteristics of the Means of Testing

For dynamic conformance testing, the means of testing shall support the following functions in addition to the general function given in clause 2.1 above.

1. Capability to construct LLC Type 1 TEST and XID frames and send them a peer LLC IUT over an appropriate LAN protocol (8802-3, 8802-4 or 8802-5) for the SUT.
2. Capability to receive and decode LLC type 1 frames.
3. Capability to construct LLC type 1 XID and TEST frames with valid and invalid address fields.

2.3.2.3. Test Suite Coverage

The test suite shall contain tests which verify the following.

1. XID request and response frame exchanges.
2. TEST request and response frame exchanges.
3. Use of individual, group and global addresses.
4. Response to XID and TEST request frames with individual, group and global addresses.

In addition, by utilizing the layer 4 protocol PDU exchanges or basic relay PDU transfers, the functionality of UI frames at LLC can be inferred.

2.3.3. 8802-3 (CSMA/CD) MAC

2.3.3.1. Configuration of the Means of Testing

Conformance testing of 8802-3 (CSMA/CD) MAC layer operation is conducted over tested physical layer and media. 8802-3 MAC sublayer operates over various 8802-3 physical layer implementations. The LLC Type 1 TEST frame response capability in SUTs is used for the testing

of 8802-3 MAC to cause the data frame exchange between the IUT and the Means of Testing.

The testing method for the 8802-3 MAC is remote embedded.

2.3.3.2. Characteristics of the Means of Testing

For dynamic conformance testing, the means of testing shall support the following functions in addition to the general function given in clause 2.1 above.

1. Capability to construct 8802-3 MAC frames containing 8802-2 LLC type 1 Test Request and send them to a peer 8802-3 MAC IUT over an appropriate 8802-3 physical layer implementation for the SUT.
2. Capability to receive and decode 8802-3 MAC frames.
3. Capability to construct valid and invalid 8802-3 MAC frames.
4. Capability to generate traffic on the medium of variable length.
5. Capability to generate collision with 8802-3 MAC frames transmitted by the IUT at a predetermined point on the IUT's frame transmission.
6. Capability to monitor the occurrences of collisions and their duration.

2.3.3.3. Test Suite Coverage

The test suite shall contain tests which verify the following.

1. Valid use of, and response to different types of MAC addresses.
2. Adherence to the minimum frame size with the valid use of PAD along with the correct length field value.
3. 8802-3 MAC frame construction.
4. Response to frames with valid and invalid frame length field values.
5. Octet alignment procedure.
6. Response to frames with valid and invalid FCS.
7. Collision detection capability and behavior upon the detection of collisions.

2.3.4. 8802-4 (Token Bus) MAC

2.3.4.1. Configuration of the Means of Testing

Conformance testing of 8802-4 (Token Bus) MAC layer operation is conducted over tested physical layer and media. The 8802-4 MAC sublayer operates over various 8802-4 physical layer implementations. The LLC Type 1 TEST frame response capability in SUTs is used for the testing of 8802-4 MAC.

The testing method for the 8802-4 MAC is remote embedded.

2.3.4.2. Characteristics of the Means of Testing

For dynamic conformance testing, the means of testing shall support the following functions in addition to the general function given in clause 2.1 above.

1. Capability to construct 8802-4 MAC frames and 8802-4 MAC data frame containing 8802-2 LLC type 1 Test Request and send them to a peer 8802-4 MAC IUT over the appropriate 8802-4 physical layer implementation.
2. Capability to construct 8802-4 frames with different addresses to emulate frame exchanges among multiple stations.
3. Capability to construct and send valid and invalid 8802-4 MAC frames.
4. Capability to transmit opportune and inopportune 8802-4 MAC frames.
5. Capability to validate the timing of the IUT frame transmissions.
6. Capability to receive and decode 8802-4 MAC frames.

2.3.4.3. Test Suite Coverage

The test suite shall contain tests which verify the following. The verification should include the normal and fault conditions with correct handling of priority and timing requirements.

1. Claim token algorithm.
2. Token passing capabilities.
3. Ring entry and exit algorithms.
4. Ring maintenance mechanisms.
5. Ring collapse recovery capability including the handling of duplicate addresses.
6. Use token algorithm.
7. Handling of traffic generated by other stations, including collisions.

Test suite coverage should be appropriate for the requirements imposed by different physical layer implementations in accordance with the 8802-4 standard.

2.3.5. 8802-5 (Token Ring) MAC

2.3.5.1. Configuration of the Means of Testing

Conformance testing of 8802-5 (Token Ring) MAC layer operation is conducted over tested physical layer and media. The 8802-5 MAC sublayer operates over various 8802-5 physical layer implementations. The LLC Type 1 TEST frame response capability in SUTs is used for the

testing of 8802-5 MAC.

The testing method for the 8802-5 MAC is remote embedded.

2.3.5.2. Characteristics of the Means of Testing

For dynamic conformance testing, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1. Capability to construct 8802-5 MAC frames and 8802-5 MAC data frame containing 8802-2 LLC type 1 Test Request and send them to a peer 8802-5 MAC IUT over the appropriate 8802-5 physical layer implementation.
2. Capability to construct 8802-5 frames with different addresses to emulate frame exchanges among multiple stations.
3. Capability to construct and send valid and invalid 8802-5 MAC frames.
4. Capability to transmit opportune and inopportune 8802-5 MAC frames.
5. Capability to validate the timing of IUT frame transmissions.
6. Capability to receive and decode 8802-5 MAC frames.

2.3.5.3. Test Suite Coverage

The test suite shall contain tests which verify the following.

1. Capability to construct valid MAC control and data frames.
2. Standby monitor.
3. Claim token capabilities and data frame transmission capability with adherence to the priority rules.
4. Transmission window observance and correct token release mechanism.
5. Token passing mechanism under different priority relationship to other stations on the ring.
6. Frame stripping.
7. Capability to receive frames and check for their validity.
8. Error handling and recovery mechanisms including beaconing and neighbor notification.
9. Ring entry and exit.

2.4 Network

2.4.1 X.25 (1980)

So long as attachment to X.25 (1980) networks is required by an Acquisition Authority, the test method and test suites mandated for

Department of Defense use shall be adopted by this policy (see [NIST 5]).

2.4.2 X.25 (1984)

2.4.2.1 Configuration of the Means of Testing

Conformance testing of the packet protocol of X.25 (1984) DTE systems is conducted in conjunction with HDLC(LAPB), over a tested physical medium, in the following configurations.

X.25/HDLC(LAPB)/RS232C
X.25/HDLC(LAPB)/V.35

For calls initiated by the means of testing the remote single-layer method shall be used. For calls initiated by the SUT, either distributed single layer or distributed layer single embedded methods shall be used. The means of testing shall take the role of a DCE.

2.4.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the functions specified in 2.1 above.

1) The capability to construct X.25 packets and send them to an attached DTE system.

2) The capability to receive and decode X.25 packets according to IS 8208. The capability to validate X.25 packets received and record the results in a conformance log.

3) The capability to construct invalid as well as valid X.25 packets.

4) The capability to monitor and initiates exchanges of X.25 packets between the means of testing and the SUT (inopportune as well as normal).

2.4.2.3 Test Suite Coverage

The tests used shall be those specified in the X.25 DTE Conformance Testing - Packet Level Conformance Test Suite [ISO 5].

2.4.3 Connectionless Network Protocol (CLNP): End Systems

2.4.3.1 Configuration of the Means of Testing

Conformance testing of CLNP End Systems is conducted in conjunction with the transport protocol, class 4, over previously tested subnetwork services of the following configurations.

- X.25/HDLC/RS232C;
- X.25/HDLC/V.35;
- 8802.2/8802.3;
- 8802.2/8802.4;
- 8802.2/8802.5;
- Other network, link and physical media as sanctioned by future editions of GOSIP.

The preferred method of realizing CLNP End System testing is by use of a transport reference entity over a CLNP Test implementation, with coordination provided by a test management protocol. This is the coordinated single-layer embedded method of testing.

2.4.3.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct CLNPDUs according to both the fully segmenting and the non-segmenting subsets, and send them to a CLNP End System Under Test over any supported medium.

2) Capability to receive and decode CLNPDUs according to IS 8473. Capability to validate CLNPDUs received and record the results.

3) Capability to construct invalid as well as valid CLNPDUs.

4) Capability to monitor and to initiate CLNPDU exchanges with the SUT and to record the results.

5) Capability to control and coordinate with the SUT in order to induce the SUT to generate specified types of CLNPDUs. This includes control and coordination with the transport class 4 entity associated with the CLNP IUT.

2.4.3.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the CLNP IUT.

- Responses to valid data and Error CLNPDUs.
- Ability to generate valid data and Error CLNPDUs.
- Responses to invalid data and Error CLNPDUs.
- Responses to inopportune data and Error CLNPDUs.
- In the case of a connection oriented subnetwork, response to loss, reset, and restart of the network connection(s).

Specific functions for which tests shall exist include the following:

- PDU composition;
- PDU decomposition;

- Header format analysis;
- PDU lifetime control;
- Route PDU;
- Forward PDU;
- Segment PDU;
- Reassemble PDU;
- Discard PDU;
- Error reporting;
- Header error detection;
- Complete route recording (decoding on receipt);
- Partial route recording (decoding on receipt);
- Priority;
- QOS maintenance;
- Padding.

2.4.4 Connectionless Network Protocol: Intermediate Systems

For the purposes of GOSIP Version 1.0, Intermediate System testing shall include IS 8473 only. The ES-IS routing protocol, IS 9542 is not a requirement until GOSIP Version 2.0. Consequently no testing requirements for ES-IS are specified here.

2.4.4.1 Configuration of the Means of Testing

Testing for Intermediate Systems shall be conducted by interposing the System Under Test between a pair of testers which incorporate CLNP End System implementations. Coordination shall be by Test Management Protocol between the pair of testers, which may operate directly over the CLNP protocol, or over transport class 4. This is the transverse method of testing. This configuration holds for each subnetwork pair supported by the SUT. The subnetwork profiles are drawn from the following:

- X.25/HDLC/RS232C;
- X.25/HDLC/V.35;
- 8802.2/8802.3;
- 8802.2/8802.4;
- 8802.2/8802.5;
- Other network, link and physical media as sanctioned by future editions of GOSIP.

2.4.4.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct CLNPDUs according to both the fully segmenting and the non-segmenting subsets, and send them to an CLNP End System Under Test over any supported medium.

2) Capability to receive and decode CLNPDUs according to IS 8473.

Capability to validate received CLNPDUs and record the results.

3) Capability to construct invalid as well as valid CLNPDUs.

4) Capability to monitor and to initiate CLNPDU exchanges with the SUT and to record the results.

5) Capability to control and coordinate with a second means of testing to generate specified types of CLNPDU. All CLNPDUs passing between the pair of testers are routed through the SUT.

2.4.4.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the CLNP IUT.

- Responses to valid data and Error CLNPDUs.
- Ability to generate valid data and Error CLNPDUs.
- Responses to invalid data and Error CLNPDUs.
- Responses to inopportune data and Error CLNPDUs.
- In the case of a connection oriented subnetwork, response to loss, reset, and restart of the network connection(s).

Specific functions for which tests shall exist include the following:

- PDU composition;
- PDU decomposition;
- Header format analysis;
- PDU lifetime control;
- Route PDU;
- Forward PDU;
- Segment PDU;
- Reassemble PDU;
- Discard PDU;
- Error reporting;
- Header error detection;
- Complete route recording (decoding on receipt);
- Partial route recording (decoding on receipt);
- Priority;
- QOS maintenance;
- Padding;
- Tests for support of CLNPDU segmentation by the Intermediate System;
- Tests for behavior of the Intermediate System under lifetime expiration;
- Congestion notification tests.

2.5 Transport

The classes of transport sanctioned by GOSIP are class 4 and class 0. In this clause, the requirement of single-layer "exposed" testing methods only is discussed.

2.5.1 Class 4

2.5.1.1 Configuration of the Means of Testing

Conformance testing of transport class 4 shall be conducted in conjunction with, or after, testing of CLNP. Alternatively, Class 4 may be operated over X.25 Connection Oriented Network Service. Coordination is by use of a Test Management Protocol operating over transport. This is the coordinated single layer method of testing. Network profiles for support of Class 4 may be.

- X.25/HDLC/RS232C;
- X.25/HDLC/V.35;
- CLNP/X.25/HDLC/RS232C;
- CLNP/X.25/HDLC/V.35;
- CLNP/8802.2/8802.3;
- CLNP/8802.2/8802.4;
- CLNP/8802.2/8802.5;
- Other network, link and physical media as sanctioned by future editions of GOSIP.

2.5.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct TPDUs according to the class 4 protocol and send them to a peer transport entity under test, over an CLNP service or X.25 network-layer service.

2) Capability to receive and decode TPDUs and classify them according to IS 8073. Capability to validate received TPDUs and record the results.

3) Capability to construct invalid as well as valid TPDUs.

4) Capability to monitor and to initiate TPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to support multiple concurrent transport connections; ability to multiplex more than one transport connection over a single X.25 connection; ability to split a transport connection across more than one X.25 connection.

6) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of TPDU. This includes control and coordination using specific test coordination procedures, which may be in the form of a Test Management Protocol, at the transport service or in conjunction with transport protocol data.

2.5.1.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the class 4 IUT.

- Negotiate during connection establishment, and support throughout the connection, those options identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from inopportune TPDUs, in all states.
- Recovery from invalid TPDUs.

Specific functions for which tests shall exist include the following:

- Assignment to network connection (for TP4 over CONS);
- TPDU transfer;
- Segmenting and Reassembling;
- Concatenation and Separation;
- Connection establishment, including: initiating a valid class 4 CR TPDU and accepting a valid class 4 CC TPDU in response; responding to a valid class 4 CR TPDU with a valid class 4 CC TPDU;
- Connection refusal;
- Explicit normal release;
- Association of TPDUs with transport connection;
- DT TPDU numbering;
- Expedited data transfer (network normal variant);
- Retention until acknowledgement of TPDUs;
- Multiplexing and demultiplexing (multiple transport connections over a single network connection, or multiple transport connections over a CLNS);
- Use of explicit flow control;
- Use or non-use of checksum;
- Frozen references;
- Retransmission on timeout;
- Resequencing;
- Inactivity control;
- Treatment of protocol errors;
- Splitting and recombining.

2.5.2 Class 0

2.5.2.1 Configuration of the Means of Testing

Conformance testing of transport class 0 shall be conducted in conjunction with, or after, testing of X.25. Coordination is by use of a Test Management Protocol operating over transport. This is the

coordinated single layer method of testing. Network profiles are as follows.

- X.25/HDLC/RS232C;
- X.25/HDLC/V.35.

2.5.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct TPDUs according to the class 0 protocol and send them to a peer transport entity under test, over an X.25 network-layer service.

2) Capability to receive and decode TPDUs and classify them according to IS 8073. Capability to validate received TPDUs and record the results.

3) Capability to construct invalid as well as valid TPDUs.

4) Capability to monitor and to initiate TPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of TPDU. This includes control and coordination using specific test coordination procedures, which may be in the form of a Test Management Protocol, at the transport service or in conjunction with transport protocol data.

6) Capability to manage successive underlying X.25 connections and to arbitrarily reset, restart or disconnect.

2.5.2.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the class 0 IUT.

- Negotiate during connection establishment, and support throughout the connection, the options of the session protocol identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent PDU exchanges.
- Recovery from inopportune TPDUs, in all states.
- Recovery from invalid TPDUs.
- Recovery from loss, reset or restart of the X.25 connection.

Specific functions for which tests shall exist include the following:

- Assignment to network connection;
- TPDU transfer;
- Segmenting and reassembly;
- Connection establishment, including: initiating a valid class 0 CR TPDU and accepting a valid class 0 CC TPDU in response; responding to a valid class 0 CR TPDU with a valid class 0 CC TPDU;
- Connection refusal;
- Implicit normal release;
- Error release, including response to loss, reset or restart of the network connection;
- Association of TPDUs with transport connections;
- Non-use of explicit flow control;
- Non-use of checksum;
- Treatment of protocol errors.

2.6 Session

GOSIP 1.0 includes both FTAM and MHS applications which use different functional subsets of the session protocol. A supplier may package the session functionality in different ways, according to the application supported, or may choose to provide an independent session service. The test methods described in this clause shall be selected according to the configuration of the supplier's product tested.

If a session product is tested by the single-layer method, then comprehensive retesting is not necessary for each different application which it supports. If a product is tested by one of the embedded methods, then retesting is required for each different application and mode of use. Specifically, the different embedded methods of testing do not substitute for each other, but single-layer "exposed" testing subsumes the other methods.

2.6.1 Exposed Session Service

All Tested Transport Platforms are applicable.

2.6.1.1 Configuration of the Means of Testing

Conformance testing of session may be conducted independently, over a previously tested GOSIP transport platform. An exposed session means of testing shall be capable of testing all functional units of the session protocol, even though any specific implementation might support only one or more of the major subsets. Coordination between tester and IUT may be by agreed test coordination procedures, or by an explicit Test Management Protocol. This uses the coordinated single-layer, or the distributed single-layer, method of testing.

2.6.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct SPDUs and send them to a peer session entity under test over a transport-layer service.

2) Capability to receive and decode SPDUs and classify them according to IS 8327. Capability to validate SPDUs received and record the results.

3) Capability to construct invalid as well as valid SPDUs.

4) Capability to monitor and initiate SPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of SPDU. This includes control and coordination using specific test coordination procedures, which may be in the form of a Test Management Protocol, at the session service or in conjunction with session protocol data.

2.6.1.3 Test Suite Coverage

- Negotiate and support throughout the connection the functional units and options of the session protocol which are identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent PDU exchanges.
- Recovery from Inopportune SPDUs in all states.
- Recovery from Invalid SPDUs, where specified by IS 8327.
- Response to valid and invalid SPDU concatenation sequences.
- Recovery from different uses of the underlying transport connection, including spurious disconnection, and use of expedited service when they are not requested.

Specific functions for which tests shall exist include the following:

- Connection establishment, including: initiating a valid connect SPDU and accepting a response of an accept SPDU or refuse SPDU; accepting a valid connect SPDU and responding with an accept SPDU or refuse SPDU, as appropriate.
- Normal data transfer, half-duplex and duplex;
- Token management;
- Exception reporting;
- Typed data transfer;

- Minor synchronization point;
- Major synchronization point;
- Resynchronize;
- Expedited data transfer;
- Activity management;
- Capability data exchange;
- Orderly connection release;
- Disorderly connection release.

2.6.2 Remote Single-layer Embedded Session Testing for FTAM

2.6.2.1 Configuration of the Means of Testing

Conformance testing of session may be conducted in conjunction with FTAM, ACSE and presentation, over a tested GOSIP transport platform. An embedded means of testing for the session protocol configured for FTAM support shall be capable of testing Kernel, Duplex, Minor Synchronization and Resynchronize functional units. There are no explicit test coordination requirements for the remote single-layer embedded method of testing. All Tested Transport Platforms are applicable.

2.6.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct SPDUs and send them to a peer session entity under test over a transport-layer service.

2) Capability to receive and decode SPDUs and classify them according to IS 8327. Capability to validate SPDUs received and record the results.

3) Capability to construct invalid as well as valid SPDUs.

4) Capability to monitor and initiate SPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

2.6.2.3 Test Suite Coverage

- Negotiate and support throughout the connection the functional units and options of session which are identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent PDU exchanges.
- Recovery from Inopportune SPDUs in all states.

- Recovery from Invalid SPDUs, where specified by IS 8327.
- Response to valid and invalid SPDU concatenation sequences.
- Recovery from different uses of the underlying transport connection, including spurious disconnection, and use of expedited when not requested.

Specific functions for which tests shall exist include the following:

- Connection establishment, including: accepting a valid connect SPDU and responding with accept SPDU or refuse SPDU, as appropriate;
- Normal data transfer, and duplex;
- Minor synchronization point;
- Resynchronize;
- Orderly connection release;
- Disorderly connection release.

2.6.3 Distributed Single-layer Embedded Session Testing for FTAM

2.6.3.1 Configuration of the Means of Testing

Conformance testing of session may be conducted in conjunction with FTAM, ACSE and presentation, over a tested GOSIP transport platform. An embedded means of testing for the session protocol configured for FTAM support shall be capable of testing Kernel, Duplex, Minor Synchronization and Resynchronize functional units. Test coordination is by agreed procedures between Test laboratory and product supplier. This is the distributed single-layer embedded method of testing. All Tested Transport Platforms are applicable.

2.6.3.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct SPDUs and send them to a peer session entity under test over a transport-layer service.

2) Capability to receive and decode SPDUs and classify them according to IS 8327. Capability to validate SPDUs received and record the results.

3) Capability to construct invalid as well as valid SPDUs.

4) Capability to monitor and initiate SPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order

to induce the SUT to generate specified types of SPDU. This control and coordination of an embedded session entity is effected by manipulation of higher layer PDUs which drive the session service.

2.6.3.3 Test Suite Coverage

- Negotiate and support throughout the connection the functional units and options of the session protocol which are identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from Inopportune SPDUs in all states.
- Recovery from Invalid SPDUs, where specified by IS 8327.
- Response to valid and invalid SPDU concatenation sequences.
- Recovery from different uses of the underlying transport connection, including spurious disconnection, and use of expedited when not requested.

Specific functions for which tests shall exist include the following:

- Connection establishment, including: initiating a valid connect SPDU and accepting a response of accept SPDU or refuse SPDU, as appropriate;
- Normal data transfer, and duplex;
- Minor synchronization point;
- Resynchronize;
- Orderly connection release;
- Disorderly connection release.

2.6.4 Distributed Single-layer Embedded Session Testing for MHS

2.6.4.1 Configuration of the Means of Testing

Conformance testing of session may be conducted in conjunction with the X.400 series of protocols (MHS - P2, P1 and RTS), over a tested GOSIP transport platform. Any embedded means of testing a session implementation configured for MHS support shall be capable of testing: Kernel, Exceptions, Activity Management, Half-duplex, and Minor Synchronization functional units. Test coordination is by agreed procedures between the test laboratory and product supplier. This is the distributed single-layer embedded method of testing. All Tested Transport Platforms are applicable.

2.6.4.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct SPDUs and send them to a peer session entity under test over a transport-layer service.

2) Capability to receive and decode SPDUs and classify them according to IS 8327. Capability to validate SPDUs received and record the results.

3) Capability to construct invalid as well as valid SPDUs.

4) Capability to monitor and initiate SPDU exchanges with the SUT(inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of SPDU. This control and coordination of an embedded session entity is effected by manipulation of higher-layer PDUs which drive the session service.

2.6.4.3 Test Suite Coverage

- Negotiate and support throughout the connection the functional units and options of the session protocol which are identified within GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from Inopportune SPDUs in all states.
- Recovery from Invalid SPDUs, where specified by IS 8327.
- Response to valid and invalid SPDU concatenation sequences.
- Recovery from different uses of the underlying transport connection, including spurious disconnection, and use of expedited when not requested.

Specific functions for which tests shall exist include the following:

- Connection establishment, including:
  accepting a valid connect SPDU and responding with accept SPDU or refuse SPDU, as appropriate;
  initiating a valid connect SPDU and responding with accept SPDU or refuse SPDU as appropriate;
- Normal data transfer, half-duplex;
- Minor synchronization point;
- Orderly connection release;
- Disorderly connection release;
- Exception management;
- Activity management;
- Token management.

2.7 Presentation

2.7.1 Remote Single-layer Embedded Presentation Testing for FTAM

2.7.1.1 Configuration of the Means of Testing

Conformance testing of presentation may be conducted in conjunction with FTAM, ACSE and session, over a tested GOSIP transport platform. An embedded means of testing for the presentation protocol configured for FTAM support shall be capable of testing the presentation kernel functionality, and in addition provide transparent access to the session kernel, duplex, minor synchronize, and resynchronize functional units. There are no explicit test coordination requirements for the remote single-layer embedded method of testing. All Tested Transport Platforms (TTPs) are applicable. Applicable profiles are as follows.

- FTAM/ACSE/Presentation/Session/TTPs

2.7.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct PPDUs and send them to a peer presentation entity under test over a session-layer service.

2) Capability to receive and decode PPDUs and classify them according to IS 8823. Capability to validate PPDUs received and record the results.

3) Capability to construct invalid as well as valid PPDUs.

4) Capability to monitor and initiate PPDU exchanges with the SUT(inopportune as well as normal) and to record the results.

2.7.1.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the presentation IUT.

- Negotiate and support throughout the connection the functional units and options of presentation which are within GOSIP and the Stable Implementors Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from Inopportune PPDUs in all states.
- Recovery from Invalid PPDUs, where specified by IS 8823.

- Recovery from different uses of the underlying session connection.

Specific functions for which tests shall exist include the following:

- Accepting a valid CP PPDU and responding with CPA PPDU or CPR PPDU, as appropriate;
- Presentation kernel tests including the above connection establishment tests, plus transfer of normal data and release of a presentation connection;
- Selection of transfer syntax;
- Selection of abstract syntax, including ACSE.

Transparent use of all required session services including:

- Normal data transfer, half-duplex and duplex;
- Minor synchronization point;
- Resynchronize;
- Orderly connection release;
- Disorderly connection release.

2.7.2 Distributed Single-layer Embedded Presentation Testing for FTAM

2.7.2.1 Configuration of the Means of Testing

Conformance testing of presentation may be conducted in conjunction with FTAM, ACSE and session, over a tested GOSIP transport platform. An embedded means of testing for the presentation protocol configured for FTAM support shall be capable of testing the presentation kernel functionality, and in addition provide transparent access to the session kernel, duplex, minor synchronize, and resynchronize functional units. Test coordination is by agreed procedures between the test laboratory and the product supplier. This uses the distributed single-layer embedded method of testing. All Tested Transport Platforms (TTPs) are applicable.
Applicable profiles are:

- FTAM/ACSE/Presentation/Session/TTPs.

2.7.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to general functions given in clause 2.1 above.

1) Capability to construct PPDUs and send them to a peer presentation entity under test over a session-layer service.

2) Capability to receive and decode PPDUs and classify them

according to IS 8823. Capability to validate PPDUs received and record the results.

3) Capability to construct invalid as well as valid PPDUs.

4) Capability to monitor and initiate PPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of PPDU. This control and coordination of an embedded presentation entity is effected by manipulation of higher layer PDUs which drive the presentation service.

2.7.2.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the presentation IUT.

- Negotiate and support throughout the connection the functional units and options of presentation which are identified within the GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent PDU exchanges.
- Recovery from Inopportune PPDUs in all states.
- Recovery from Invalid PPDUs, where specified by IS 8823.
- Recovery from different uses of the underlying session connection.

Specific functions for which tests shall exist include the following:

- Initiating a valid CP PPDU and accepting CPA PPDU or CPR PPDU, in response;
- Presentation kernel tests including the above connection establishment tests, plus transfer of normal data and release of a presentation connection;
- Selection of transfer syntax;
- Selection of abstract syntax, including ACSE.

- Transparent use of all required session services including:

  Normal data transfer, half-duplex and full duplex,
  Minor synchronization point,
  Resynchronize,
  Orderly connection release, and
  Disorderly connection release.

2.8 ASN.1

Tests for encoding and decoding of ASN.1 transfer syntax are incorporated in the test suites for the application protocols, where appropriate.

3. APPLICATION PROFILE TESTING CONSTRAINTS

Application protocols are treated in a separate clause from supporting profiles because of their extent and diversity. The complete set of 7-layer profile combinations, including both Application and support profiles, is given in clause 1.5.

3.1 ACSE

3.1.1 Remote Single-Layer Embedded ACSE Testing for FTAM Responder

3.1.1.1 Configuration of the Means of Testing

Conformance testing of ACSE responders may be conducted in conjunction with FTAM, presentation and ASN.1 over a tested GOSIP session platform, or else in conjunction with FTAM, presentation, ASN.1 and session over a tested GOSIP transport platform. Test coordination is implicit, since the only point of control and observation is remote using the transport (or session) service. This uses the remote single-layer embedded method of testing. All Tested Transport Platforms (TTPs) are applicable. Applicable profiles are:

- FTAM/ACSE/Presentation/Session/TTPs.

3.1.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct APDUs and send them to a peer ACSE entity under test over a presentation-layer service.

2) Capability to receive and decode APDUs and classify them according to IS 8650. Capability to validate received APDUs and record the results.

3) Capability to construct invalid as well as valid APDUs.

4) Capability to monitor and initiate APDU exchanges with the SUT (inopportune as well as normally) and to record the results.

3.1.1.3 Test Suite Coverage

The test suite shall contain tests for the following general

behaviors of the ACSE IUT.

- Negotiate and support throughout the connection the functional units and options of ACSE which are identified within the GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options. Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from inopportune APDUs in all states.
- Recovery from invalid APDUs, where specified.
- Recovery from different uses of the underlying presentation connection.

Specific functions for which tests shall exist include the following:

- Accepting a valid AARQ APDU and responding with an AARE APDU;
- Association release and abort tests.

- Transparent use of required presentation and session services including:
  Normal data transfer, and duplex,
  Minor synchronization point,
  Resynchronize,
  Orderly connection release, and
  Disorderly connection release.

3.1.2 Distributed Single-Layer Embedded ACSE Testing for FTAM Initiator

3.1.2.1 Configuration of the Means of Testing

Conformance testing of ACSE initiators may be conducted in conjunction with FTAM, presentation and ASN.1 over a tested GOSIP session platform, or else in conjunction with FTAM, presentation, ASN.1 and session over a tested GOSIP transport platform. Test coordination is by agreed procedures between test laboratory and product supplier. This uses the distributed single-layer embedded method of testing. All Tested Transport Platforms (TTPs) are applicable.

Applicable profiles are:

- FTAM/ACSE/Presentation/Session/TTPs.

3.1.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct APDUs and send them to a peer ACSE entity under test over a presentation-layer service.

2) Capability to receive and decode APDUs and classify them according to IS 8650. Capability to validate APDUs received and record the results.

3) Capability to construct invalid as well as valid APDUs.

4) Capability to monitor and initiate APDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of APDU. This control and coordination of an embedded association control entity is effected by manipulation of higher layer PDUs which drive the association control service.

3.1.2.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of the ACSE IUT.

- Negotiate and support throughout the connection the functional units and options of ACSE which are identified within the GOSIP and the Stable Implementation Agreements [NIST 2, NIST 9].
- Respond correctly to improperly negotiated options.
- Respond correctly to options negotiated properly but violated during subsequent conduct of the connection.
- Recovery from inopportune APDUs in all states.
- Recovery from invalid APDUs, where specified.
- Recovery from different uses of the underlying presentation connection.

Specific functions for which tests shall exist include:

- Accept a valid AARQ APDU and responding with an AARE APDU;
- Association release and abort tests;
- Transparent use of required presentation and session services including:
  Normal data transfer, and duplex,
  Minor synchronization point,
  Resynchronize,
  Orderly connection release, and
  Disorderly connection release.

3.2 FTAM

3.2.1 Remote Single-Layer FTAM Responder Testing

3.2.1.1 Configuration of the Means of Testing

Conformance testing of FTAM responders may be conducted in conjunction with ACSE, presentation and ASN.1 over a tested GOSIP session platform, or else in conjunction with ACSE, presentation, ASN.1 and session over a tested GOSIP transport platform. Test coordination is implicit, since the only point of control and observation is remotely over the transport (or session) service. This uses the remote single layer method of testing. All Tested Transport Platforms (TTPs) are applicable.

Applicable profiles are:

- FTAM/ACSE/Presentation/Session/TTPs.

3.2.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct FPDUs according to ISO IS 8571, using ASN.1 in conjunction with ACSE PDUs, and send them to a peer FTAM entity under test over a presentation-layer service.

2) Capability to receive and decode FPDUs encoded using ASN.1. Capability to reconcile received FPDUs with those previously sent and record the results.

3) Capability to construct invalid as well as valid FPDUs.

4) Capability to monitor and initiate FPDU exchanges with the SUT (inopportune as well as normal) and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of FPDU.

6) Capability to negotiate and encode specified document types.

7) Capability to decode document types according to ISO IS 8571.

8) Capability to negotiate and enforce specified implementation profiles.

3.2.1.3 Test Suite Coverage

The Test Suite shall contain tests for the following general behaviors of the FTAM responder.

- Negotiation and support throughout the association of the

document types and implementation profiles which are identified within the GOSIP and the Stable Implementation Agreements [NIST 9].

- Response to inopportune FPDUs.
- Response to invalid FPDUs, where specified.
- Response to valid and invalid Grouping sequences.
- Response to different uses by the means of testing of the associated ACSE unit.
- Response to different uses of the underlying presentation connection.

Specific functions for which tests shall exist include the following:

- FTAM Regime establishment, including:
  response to a valid F_initiate_Request specifying a statically agreed service class,
  initiation of a valid F_Initialize_Response confirming the same service class, or lesser functionality;
- FTAM regime termination (orderly);
- File selection;
- File deselection;
- File open;
- File close;
- Locate;
- Erase;
- File creation;
- File deletion;
- Read attributes;
- Change attributes;
- Begin group;
- End group;
- FTAM regime termination (abrupt);
- Treatment of protocol errors.

Document types for which tests shall exists include the following:

- FTAM-1.
- FTAM-2;
- FTAM-3;
- NBS-6;
- NBS-7;
- NBS-8;
- NBS-9.

Implementation profiles for which tests shall exist include the following:

- T1: simple file transfer;
- T2: positional file transfer;
- T3: full file transfer;
- A1: simple file access;
- A2: full file access;
- M1: management.

3.2.2 Distributed Single-Layer FTAM Initiator Testing

3.2.2.1 Configuration of the Means of Testing

Conformance testing of FTAM initiators may be conducted in conjunction with ACSE, presentation and ASN.1 over a tested GOSIP session platform, or else in conjunction with ACSE, presentation, ASN.1 and session over a tested GOSIP transport platform. Test coordination is by agreed procedures between test laboratory and product supplier. This uses the distributed single layer method of testing. All Tested Transport Platforms (TTPs) are applicable. Applicable profiles are:

- FTAM/ACSE/Presentation/Session/TTPs.

3.2.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct FPDUs according to ISO IS 8571, using ASN.1 in conjunction with ACSE PDUs, and send them to a peer FTAM entity under test, in response to FPDUs initiated by the SUT, over a presentation-layer service.

2) Capability to validate received FPDUs and record the results.

3) Capability to construct invalid as well as valid FPDUs.

4) Capability to monitor (inopportune as well as normal) FPDU exchanges with the SUT and to record the results.

5) Capability to control and to coordinate with the SUT in order to induce the SUT to generate specified types of FPDU. This includes control and coordination using specified test coordination procedures.

6) Capability to negotiate and encode specified document types.

7) Capability to decode document types according to ISO IS 8571.
8) Capability to negotiate and enforce specified implementation profiles.

3.2.2.3 Test Suite Coverage

The Test Suite shall contain tests for the following behaviors of the FTAM Initiator.

- Negotiation and support throughout the association of the document types and implementation profiles which identified

are within GOSIP and the Stable Implementation Agreements [NIST 9].
- Response to inopportune FPDUs.
- Response to invalid FPDUs, where specified.
- Response to valid and invalid Grouping sequences.
- Response to different uses by the means of testing of the associated ACSE unit.
- Response to different uses of the underlying presentation connection.

Specific functions for which tests shall exist include the following:

- FTAM Regime establishment, including:
  Initiation of a valid F_initiate_Request specifying a statically agreed service class,
  acceptance of a valid F_Initialize_Response confirming the same service class, or lesser functionality;
- FTAM regime termination (orderly);
- File selection;
- File deselection;
- File open;
- File close;
- Locate;
- Erase;
- File creation;
- File deletion;
- Read attributes;
- Change attributes;
- Begin group;
- End group;
- FTAM regime termination (abrupt);
- Treatment of protocol errors.

Document types for which tests shall exists include the following:

- FTAM-1;
- FTAM-2;
- FTAM-3;
- NBS-6;
- NBS-7;
- NBS-8;
- NBS-9.

Implementation profiles for which tests shall exist include the following:

- T1: simple file transfer;
- T2: positional file transfer;
- T3: full file transfer;
- A1: simple file access;
- A2: full file access;
- M1: management.

3.3 X.400 Message Handling Service

Applicable profiles are as follows:

- P2/P1/RTS/Session/TTPs

3.3.1 Distributed Single-layer Embedded RTS Testing

3.3.1.1 Configuration of the Means of Testing

Conformance testing of the Reliable Transfer Service is conducted in conjunction with the Interpersonal Message Service (IPMS, or P2), and the Message Transfer Service (P1) over a tested transport platform using the distributed single-layer embedded method of testing. Test coordination is by agreed procedures between test laboratory and product supplier. These are the End System configurations. The requirement for testing the Reliable Transfer Service (RTS) within a Message Transfer Agent (MTA) relay is for Basic Interconnection Tests only.

3.3.1.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) The capability to initiate RTS ASPs according to CCITT X.410 and send them over a session-layer service.

2) Capability to interpret received RTS ASPs and record the results.

3) Capability to initiate all primitives specified in X.410, with valid or invalid parameter values.

4) Capability to control and coordinate with the SUT in order to induce the SUT to generate specified types of RTS ASP. This includes control and coordination using specified test coordination procedures.

3.3.1.3 Test Suite Coverage

The test suite shall contain tests for the following general behaviors of an RTS entity.

- Negotiation and support throughout the association of all RTS options within the Stable Implementation Agreements [NIST 2, NIST 9].

- Exercising of all RTS abstract services specified in CCITT X.410.

- RTS encoding strategies not covered by session.

- Response to ASPs with invalid combinations of functional units.

Specific functions for which tests shall exist include the following:

- IUT accepts an association initiated by the means of testing with a valid Pconnect element; acceptance is signified by sending an Open_response primitive carrying a valid Paccept element;
- IUT initiates an association using Open_request with a valid Pconnect element, and accepts the means of testings response of Open_response carrying a Paccept element;
- Invalid association establishment attempt;
- Data transfer;
- Association termination;
- Multiple (i.e., more than one) concurrent associations established;
- Multiple consecutive session connection establishment using one RTS association.

3.3.2 Distributed Single-layer Embedded P1 Testing

3.3.2.1 Configuration of the Means of Testing

Conformance testing of the P1 message transfer service is conducted in conjunction with IPMS (P2) over a tested transport platform using the distributed single-layer embedded method of testing.

3.3.2.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct P1 PDUs according to CCITT X.411, using ASN.1, in conjunction with P2 PDUs, and send them to a peer message transfer agent entity over RTS.

2) Capability to decode and validate received P1 PDUs and record the results.

3) Capability to construct P1 PDUs with invalid structure or invalid parameter encodings.

4) Capability to monitor and initiate exchanges of P1 PDUs with the SUT and record the results.

5) Capability to control and coordinate with the SUT in order to induce the SUT to generate specified types of P1 PDU. This

includes control and coordination using specified test coordination procedures.

6) Capability to operate the underlying reliable transfer service, normally or abnormally.

3.3.2.3 Test Suite Coverage

The test suite shall contain tests for the following behaviors of the message transfer agent.

- Support of the P1 protocol elements defined in the Stable Implementation Agreements [NIST , NIST 92];
- Response to means of testing attempts to include unsupported elements in P1;
- Response to P1 PDUs carrying invalid parameter encodings and invalid values;
- Response to tester's abnormal operation of the underlying RTS.

Specific functions for which tests shall exist include the following:

- Initiation and acceptance of user MPDU, delivery report MPDU, and probe MPDU;
- Support of the following functions by Initiator or receiver:
  Content Type Indication,
  Converted Indication,
  Delivery Time Stamp Indication,
  Message Identification,
  Non-delivery Notification,
  Original Encoded Information Types Indication,
  Submission Time Stamp Indication,
  Alternate Recipient Allowed,
  Conversion Prohibition,
  Delivery Notification,
  Explicit Conversion,
  Grade of Delivery Selection,
  Multi-destination Delivery;
- Error handling test for the following actions:
  Invalid context specific tag in an MPDU,
  Pragmatic Constraints violations,
  Protocol violations (such as insufficient number of protocol elements present, or protocol elements of invalid type are present),
  ORNames with one invalid element (in different elements);
- Tests for message transfer protocol elements marked 'non-support' in the Stable Implementation Agreements [NIST 2, NIST 9];
  Deferred Delivery,
  PerDomainBilateralInfo,
  Explicit Conversion,
  Alternate Recipient Allowed,

Content Return Request;
- Tests for message transfer protocol elements marked 'not used' in the Stable Implementation Agreements [NIST 2, NIST 9];
- Tests for invalid ASN.1 encoding of P1 PDUs.

3.3.3 Distributed Single-Layer P2 Testing

3.3.3.1 Configuration of the Means of Testing

Conformance testing of the P2 interpersonal messaging service is conducted in conjunction with P1 over a tested transport platform using the distributed single-layer method.

3.3.3.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met, the means of testing shall support the following functions in addition to the general function given in clause 2.1 above.

1) Capability to construct P2 PDUs according to CCITT X.420, using ASN.1 basic encoding rules, and send them to a peer interpersonal messaging entity over a message transfer service.

2) Capability to decode and validate received P2 PDUs and record the results.

3) Capability to construct P2 PDUs with invalid structure and invalid parameter encodings.

4) Capability to monitor and initiate exchanges of P2 PDUs with the SUT and record the results.

5) Capability to control and coordinate with the SUT to induce the SUT to generate specified types of P2 PDUs. This includes control and coordination using specified test coordination procedures.

6) Capability to operate the underlying message transfer service, normally or abnormally.

3.3.3.3 Test Suite Coverage

The test suite shall contain tests for the following behaviors of the Interpersonal Messaging User Agent.

- Support of the P2 protocol elements defined in the Stable Implementation Agreements [NIST 2, NIST 9].
- Response to means of testing attempts to include unsupported elements in P2.
- Response to Inopportune P2 PDUs.
- Response to P2 PDUs carrying invalid parameter encodings and

invalid values.
- Response to tester's abnormal operation of the underlying Message Transfer Service.

Specific functions for which tests shall exist include the following:

- Initiation and acceptance of:
  User Message UAPDU, and
  Status Report UAPDU;
- Support of the following functions by initiator:
  Content Type Indication,
  Message Identification,
  Non-delivery Notification,
  Original Encoded Information Types Indication,
  Submission Time Stamp Indication,
  IP-Message Identification,
  Typed Body,
  Conversion Prohibition,
  Delivery Notification,
  Grade of Delivery Selection,
  Multi Destination Delivery,
  Originator Indication,
  Primary and Copy Recipients Indication,
  Replying IP Message Indication, and
  Subject Indication;
- Support of the following functions by receiver:Content Type Indication,
  Converted Indication,
  Delivery Time Stamp Indication,
  Message Identification,
  Original Encoded Information Types Indication,
  Submission Time Stamp Indication,
  IP-Message Identification,
  Typed Body,
  Authorizing Users Indication,
  Auto Forwarded Indication,
  Blind Copy Recipient Indication,
  Body Part Encryption Indication,
  Conversion Prohibition,
  Cross Referencing Indication,
  Disclosure of Other Recipients,
  Expiry Date Indication,
  Forwarded IP-Message Indication,
  Grade of Delivery Selection,
  Importance Indication,
  Multi Part Body,
  Obsoleting Indication,
  Originator Indication,
  Primary and Copy Recipients Indication,
  Reply Request Indication,
  Replying IP-Message Indication,
  Sensitivity Indication, and

Subject Indication;

- Test for invalid ASN.1 encoding of P2 PDUs.

3.3.4 P1 Relay Testing

3.3.4.1 Configuration of the Means of Testing

Conformance testing of a P1 relay entity is conducted by placing the relay between two MTA End Systems and operating over contiguous RTS associations using the Transverse testing method.

3.3.4.2 Characteristics of the Means of Testing

For dynamic conformance conditions to be met the means of testing shall support the following functions in addition to the general functions given in clause 2.1 above.

1) Capability to construct P1 PDUs according to CCITT X.411, using ASN.1, in conjunction with P2 PDUs, and send them to a peer Message Transfer Agent End System through a relaying MTA which is the system under test.

2) Capability to decode and validate received P1 PDUs and record the results.

3) Capability to construct P1 PDUs with invalid structure or invalid parameter encodings.

4) Capability to monitor and initiate exchanges of P1 PDUs with the SUT and record the results.

5) Capability to operate the underlying reliable transfer service, normally or abnormally.

3.3.4.3 Test Suite Coverage

The test suite shall contain tests for the following behaviors of the Message Transfer Agent relay.

- Support of the P1 protocol elements defined in the Stable Implementation Agreements [NIST 2, NIST 9].
- Response to means of testing attempts to include unsupported elements in P1.
- Response to inopportune P1 PDUs.
- Response to P1 PDUs carrying invalid parameter encodings and invalid values.
- Response to tester's abnormal operation of the underlying RTS.

Specific functions for which tests shall exist include the following:

- Acceptance and forwarding of:
  UserMPDU,
  DeliveryReportMPDU, and
  ProbeMPDU;

- Support of the following functions:
  Content Type Indication,
  Converted Indication,
  Delivery Time Stamp Indication,
  Message Identification,
  Non-delivery Notification,
  Original Encoded Information Types Indication,
  Submission Time Stamp Indication,
  Alternate Recipient Allowed,
  Conversion Prohibition,
  Delivery Notification,
  Explicit Conversion,
  Grade of Delivery Selection; and
  Multi-destination Delivery.
- Error handling test for the following actions:
  Invalid context specific tag in an MPDU
  Pragmatic Constraints violations
  Protocol violations (such as insufficient number of protocol elements present, and protocol elements of invalid type are present), and
  ORNames with one invalid element (in different elements);

- Tests for message transfer protocol elements marked 'non-support' in the Stable Implementation Agreements [NIST 2, NIST 9].
  Deferred Delivery,
  PerDomainBilateralInfo,
  Explicit Conversion,
  Alternate Recipient Allowed, and
  Content Return Request;
  - Tests for invalid ASN.1 encoding of P1 PDUs;
  - Trace information tests.

NIST-114A
(REV. 3-89)

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY

BIBLIOGRAPHIC DATA SHEET

1. PUBLICATION OR REPORT NUMBER
NISTIR 4594

2. PERFORMING ORGANIZATION REPORT NUMBER

3. PUBLICATION DATE
MARCH 1991

4. TITLE AND SUBTITLE

GOSIP CONFORMANCE AND INTEROPERATION TESTING REGISTRATION

5. AUTHOR(S)

J. Stephen Nightingale

6. PERFORMING ORGANIZATION (IF JOINT OR OTHER THAN NIST, SEE INSTRUCTIONS)

U.S. DEPARTMENT OF COMMERCE
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
GAITHERSBURG, MD 20899

7. CONTRACT/GRANT NUMBER

8. TYPE OF REPORT AND PERIOD COVERED

9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS (STREET, CITY, STATE, ZIP)

DOC/NIST/CSL
Bldg 225, Room B141
Gaithersburg, MD 20899

10. SUPPLEMENTARY NOTES

[ ] DOCUMENT DESCRIBES A COMPUTER PROGRAM; SF-185, FIPS SOFTWARE SUMMARY, IS ATTACHED.

11. ABSTRACT (A 200-WORD OR LESS FACTUAL SUMMARY OF MOST SIGNIFICANT INFORMATION. IF DOCUMENT INCLUDES A SIGNIFICANT BIBLIOGRAPHY OR LITERATURE SURVEY, MENTION IT HERE.)

This report identifies requirements for conformance testing and interoperability testing of GOSIP Version 1.0 protocols and protocol stacks. The framework includes quality and coverage requirements for conformance test systems and test suites and identifies NVLAP as the responsible body for deploying laboratory accreditation procedures for interoperability testing as described in the report. The U.S. GOSIP Testing Program maintains and publishes registers of conformance test suites, means of testing, accredited laboratories, conformance tested GOSIP products, reference implementations, reference interoperability tested products, interoperability test suites, and interoperability testing services. The report gives criteria for entry onto these registers.

12. KEY WORDS (6 TO 12 ENTRIES; ALPHABETICAL ORDER; CAPITALIZE ONLY PROPER NAMES; AND SEPARATE KEY WORDS BY SEMICOLONS)

Abstract Test Suites; Conformance Testing; FTAM; Government OSI Profile (GOSIP); Laboratory Accreditation; Open Systems Interconnection (OSI); Product Registration; X.400

13. AVAILABILITY

[X] UNLIMITED

[ ] FOR OFFICIAL DISTRIBUTION. DO NOT RELEASE TO NATIONAL TECHNICAL INFORMATION SERVICE (NTIS).

[ ] ORDER FROM SUPERINTENDENT OF DOCUMENTS, U.S. GOVERNMENT PRINTING OFFICE, WASHINGTON, DC 20402.

[X] ORDER FROM NATIONAL TECHNICAL INFORMATION SERVICE (NTIS), SPRINGFIELD, VA 22161.

14. NUMBER OF PRINTED PAGES
93

15. PRICE
A05

ELECTRONIC FORM