

Recommendation X.403

MESSAGE HANDLING SYSTEMS - CONFORMANCE TESTING

The CCITT,

considering

- (a) the need for Message Handling Systems;
- (b) the need to ensure the interoperability of Message Handling Systems;
- (c) the need for conformance testing specifications for Message Handling Systems;
- (d) that the X.400-Series Recommendations specify Message Handling Systems;
- (e) the state-of-the-art of OSI testing methodology and notation within CCITT-ISO,

unanimously declares

- (1) that this Recommendation describes the testing methodology for Message Handling Systems;
- (2) that this Recommendation describes a notation used to define test specifications for Message Handling Systems;
- (3) that this Recommendation describes the scope and content of CCITT Conformance Testing Specification Manuals for Message Handling Systems.

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0. Introduction

This Recommendation describes the test methods, test criteria and test notation to be used for the conformance testing of message handling systems based on the 1984 X.400 series of Recommendations as supplemented by the X.400-Series Implementor's Guide (version 5).

1. Scope and Field of Application

The message handling protocols in the scope of this Recommendation are contained in the 1984 X.400-Series of Recommendations together with the X.400 series Implementor's Guide (version 5).

Abstract test specifications for these are contained in the CCITT Conformance Testing Specification Manuals associated with this Recommendation:

- Conformance Testing Specification Manual for IPMS(P2)
- Conformance Testing Specification Manual for MTS(P1)
- Conformance Testing Specification Manual for RTS

Even though these Manuals are referred to by this Recommendation they are not part of it.

While the complete and correct operation of session, transport and other lower-layer protocols is required for interworking the testing of these layers is not in the scope of this Recommendation.

On the other hand, X.400 conformance tests should verify that the Reliable Transfer Server (RTS) correctly uses the layers beneath it.

The tests defined in this document apply to inter-domain working (ADMD to ADMD and ADMD to PRMD). They relate to any MTA or UA in a domain that supports communications with other domains.

Conformance testing of the semantics and syntax of the actual body part information carried in a BODY PART is beyond the scope of this document.

The purpose of this Recommendation is to minimize the time and expense that manufacturers of X.400 implementations and providers of X.400 services must incur to ensure a high degree of interoperability of their equipment. This purpose is achieved by having a set of X.400 conformance test specifications. The successful joint execution of the test specifications by two implementations can be accepted as compelling evidence of the complete and correct operation of these implementations.

The scope and intention of this Recommendation is different from other CCITT Recommendations which define communication services and protocols such as the 1984 X.400-Series of Recommendations. The purpose of the latter Recommendations is to unambiguously define a system. However a Recommendation for conformance testing provides a well chosen subset of tests of the virtually infinite number of tests needed to guarantee full compliance to a protocol standard. The subset is chosen in such a way that it gives a high level of confidence that tested implementations will interwork while taking into account pragmatic considerations such as time taken to perform the tests.

Testing for conformance to functional standards is beyond the scope of this Recommendation. However it is recognized that conformance tests for functional standards can be derived from this Recommendation and the associated Test Specification Manuals.

It should be recognized that the conformance testing of message handling systems may fall within the framework of national regulations and may be subject to the testing policies of Administrations which are beyond the scope of this document.

2. References

X.400 Message Handling Systems: System Model-Service Elements, version 1984.

X.401 Message Handling Systems: Basic service elements and optional user facilities, version 1984.

- X.408 Message Handling Systems: Encoded information type conversion rules, version 1984.
- X.409 Message Handling Systems: Presentation transfer syntax and notation, version 1984.
- X.410 Message Handling Systems: Remote operations and reliable transfer server, version 1984.
- X.411 Message Handling Systems: Message transfer layer, version 1984.
- X.420 Message Handling Systems: Interpersonal messaging user agent layer, version 1984.
- X.210 Open Systems Interconnection (OSI) Layer Service Definitions Convention, version 1984.
- X.400 Series (1984) Implementor's Guide version 5.

3. Definitions

3.1 Service Convention Definitions

This Recommendation makes use of the following terms defined in Recommendation X.210, version 1984:

- a) primitive;
- b) request (primitive);
- c) indication (primitive);
- d) response (primitive);
- e) confirm (primitive).

3.2 Message Handling Definitions

This Recommendation makes use of the following terms defined in Recommendation X.400, version 1984:

- a) administration management domain;
- b) interpersonal message [X.420];
- c) message;
- d) message transfer [X.411];

- e) originator;
- f) private management domain;
- g) recipient;
- h) user.

4. Abbreviations

The following abbreviations are used in this Recommendation:

ADMD Administration management domain;

ASP Abstract Service Primitive;

DSE Distributed Single layer Embedded testmethod;

MHS Message Handling System;

IPMS Interpersonal Messaging System;

IUT Implementation Under Test;

MPDU Message Protocol Data Unit;

MT Message Transfer;

MTA Message Transfer Agent;

MTS Message Transfer System;

P1 The Message Transfer Protocol [X.411];

P2 The Interpersonal Messaging Protocol [X.420];

PCO Point of Control and Observation;

PICS Protocol Implementation Conformance Statement;

PIXIT Protocol Implementation Extra Information for Testing;

PDU Protocol data unit;

PRMD Private management domain;

RTS Reliable Transfer Server;

SAP Service Access Point;

TSP Test Suite Parameter;

TTCN Tree and Tabular Combined Notation;

UA User Agent.

5. Conventions

No conventions are defined for this Recommendation.

6. Overview

There are two kinds of CCITT documents concerned with X.400 Conformance testing:

- (a) This CCITT Recommendation entitled "X.403 Message Handling Systems: Conformance Testing".
- (b) Three associated CCITT Conformance Testing Specification Manuals entitled:
 - Conformance Testing Specification Manual for IPMS(P2)
 - Conformance Testing Specification Manual for MTS(P1)
 - Conformance Testing Specification Manual for RTS

The CCITT Recommendation is intended for a wide readership. The Manuals are intended for test implementors and contain detailed test specifications.

6.1 The X.400 Conformance Testing Recommendation

This Recommendation gives the following information:

- (a) Conformance requirements of X.400 implementations.
- (b) The testing methodology.
- (c) The structure of the test specifications.
- (d) Information to be supplied by implementors as a prerequisite to conformance testing.
- (e) The test notation.
- (f) Conformance assessment procedures.

6.2 The X.400 Conformance Testing Specification Manuals

Three CCITT Conformance Testing Specification Manuals contain test specifications for the IPMS(P2), MTS(P1), RTS. The test specifications are written in a notation described in general terms

in clause 11. The Conformance Testing Specification Manuals are referred to by this Recommendation but they are not part of it.

Since the Manuals contain detailed and unambiguous test specifications, users of these Manuals should be familiar with the X.400-Series of Recommendations and with the testing methodology used.

7. Conformance requirements

The purpose of the test specifications referenced by this Recommendation is to define tests that will establish to a high degree of confidence that the various protocol layers of an implementation under test conform to the requirements of the X.400 series of Recommendations (1984).

A system claiming to conform to the X.400 IPM-Service has to support correctly:

- the basic IPM service elements as defined in X.400/Table 2
- the IPM Optional User facilities defined as Essential in X.401/Table 1 and Table 2 (where the categorization for origination and reception should be considered)
- the IPM Optional User facilities defined as Additional in X.401/Table 1 and Table 2, which are claimed to be supported
- the requirements related to the IPM service as defined in version 5 of the CCITT X.400-Series Implementor's Guide.

A system claiming to conform to the X.400 MT-service has to support correctly:

- the basic MT-service elements as defined in X.400/Table 1 related to the MTS(P1) protocol
- the MT Optional User facilities defined as Essential in X.401/Table 3 and 4 and related to the MTS(P1) protocol
- the MT Optional User facilities defined as Additional in X.401/Table 3 and 4 and related to the MTS(P1) protocol, which are claimed to be supported
- the requirements related to the P1 MT-service as defined in version 5 of the CCITT X.400-Series Implementor's Guide.

A system claiming to conform to the X.400 RTS-service has to support correctly:

- the RTS-services as defined in X.410

- the requirements related to the RTS-Service as defined in version 5 of the CCITT X.400-Series Implementor's Guide.

Claims of conformance of an implementation to the X.400-Series of Recommendations can be tested using the Conformance Testing with this Recommendation to ensure that:

Specification Manuals associated

- (a) The implementation does not act or react in a way different to the one described in the Recommendations.

- (b) The implementation is capable of handling protocol errors.

The reaction of an implementation on receipt of protocol errors is not defined in the X.400 Series of Recommendations. For the purpose of conformance testing the minimum additional requirement is made that the implementation subsequently continues to operate normally in such cases.

The absence of a mandatory protocol element in P2 or P1 is regarded as a protocol error. It should be noted that in an implemented MHS a recipient domain may choose to deliver an incorrect MPDU. This should be considered as proprietary design by the equipment vendor, and the specific actions taken in these situations are defined by the vendor and not subject to conformance.

- (c) The implementation correctly handles the requirements defined in X.400 Implementor's Guide Version 5.

Maximum lengths and maximum number of occurrences are interpreted in the following way:

- on origination: the implementation may support maximum lengths/occurrences up to but not exceeding the constraint value.
- on reception: the implementation must support the maximum lengths/occurrences of the constraints. Values above the constraints may be supported but the conformance requirements on the implementation upon reception of a length/occurrence exceeding the constraint are the same as for protocol errors.

Claims of conformance to the X.400 series of Recommendations can not be tested for those implementations for which it is not possible to perform all the required tests for features labeled mandatory, basic or essential optional.

8. Testing methodology

8.1 Test configurations

Two test configurations are used. The first configuration is shown in Figure 1/X.403 and is used to test IPMS(P2), MTS(P1) and RTS.

Figure 1/X.403 End system configuration.

The second configuration is shown in Figure 2/X.403 and is used to test the relay aspects of the MTS(P1) protocol.

Figure 2/X.403 Relaying MTA test configuration.

8.2 Points of Control and Observation

Test cases are described abstractly in terms of events at points of control and observation (PCO) in both the tester and the implementation under test (IUT). These PCOs are generally Service Access Points (SAPs) and the events are generally Abstract Service Primitives (ASPs). This does not imply that manufacturers are required to have accessible SAPs or to implement ASPs within their systems. During test execution the PCOs of an IUT may be accessed indirectly through a user interface. Where testing is performed through a user interface, the mapping of events between the SAP and the user interface is provided by the supplier of the IUT as described in clause 10.2.

8.2.1 PCOs for IPMS(P2)

The IPMS(P2) test cases are described using the Points of Control and Observation (PCOs) shown in Figure 3/X.403:

Figure 3/X.403 Points of control and observation for IPMS(P2).

For the tester, the Point of Control and Observation is the Service Access Point (SAP) defined at the boundary between the User Agent Layer and the Message Transfer Layer. This PCO makes use of the Message Transfer Layer Service Primitives defined in Recommendation X.411.

For the IUT, the PCO is the SAP defined at the upper boundary of the User Agent Layer. However Recommendation X.420 does not include definition of Service Primitives and it has therefore been necessary to construct hypothetical ones for sending and receiving IP-messages, in order that the test cases can be described in a formal way.

8.2.2 PCOs for MTS(P1)

The MTS(P1) test cases are described using the PCOs shown in Figure 4/X.403:

Figure 4/X.403 Points of control and observation for MTS(P1).

For the tester, the PCO is the SAP defined at the boundary between the MT Layer and the RTS. This PCO makes use of the RTS primitives defined in Recommendation X.410.

For the IUT, the PCO is the SAP defined at the boundary between the UA Layer and the MT Layer. This PCO makes use of the MT Service Primitives defined in Recommendation X.411.

The testing of relay functions requires more than one tester SAP. Similarly the testing of multiple destination delivery requires more than one UA on the IUT.

8.2.3 PCOs for RTS

The RTS test cases are described using the PCOs shown in Figure 5/X.403:

Figure 5/X.403 Points of control and observation for RTS.

For the tester, the PCO is the SAP defined at the boundary between the RTS and the Session Layer. This PCO makes use of the Session Service Primitives defined in Recommendation X.215.

For the IUT, the PCO is the SAP defined at the upper boundary of the User Agent Layer. This PCO makes use of the same hypothetical Service Primitives defined for IPMS(P2) (section 8.2.1).

The description of the RTS test cases includes events at a third SAP at the IUT (SAP-I) between the MT Layer and RTS. The events of this SAP are used only for clarification and it is not used as a PCO.

8.3 Test Design Strategy

The MHS test specifications are designed using the following concepts:

- (a) A test specification is defined as a test suite composed of a number of test cases as defined in clause 11.1.
- (b) Test cases are defined in terms of
 - lower layer ASP events at the tester
 - upper layer ASP events at the IUT
- (c) The test cases define the sequencing of these ASP events and the associated parameters, in particular the PDUs.
- (d) Test cases for valid behaviour specify ASP event sequences and PDUs that are in accordance with the X.400 series of Recommendations.
- (e) Test cases for invalid behaviour are characterized by:
 - A correct PDU or event initiated by the tester in a protocol state where it is not permitted (an inopportune event), or
 - a correct PDU incorporating an element which is syntactically correct and in range, but conflicts with the negotiated value, or
 - a PDU sent by the tester which is syntactically incorrect (examples are a missing mandatory protocol element, an out-of-range value or an incorrectly encoded length indicator) or
 - for RTS a lower layer ASP event issued by the tester used with parameters that are not allowed or not appropriate (example SPSN in SConnect) by X.400 restrictions.
- (f) The depth of testing is restricted to a reasonable number of test cases using the following principles:

For valid behaviour:

- If there is a small number of valid protocol element values, test all of them.
- If there is a range of values, test the bounds and a few common values.
- If there are no bounds, test an extreme value besides the common ones.

For invalid behaviour:

- The number of test cases for a particular type of error is reduced to one or just a few common ones.

8.3.1 Strategy for X.409 testing

The X.409 test cases defined in the CCITT Conformance Testing Specification Manuals associated with this Recommendation are applicable only to X.400 message handling systems. The testing of X.409 is done as part of the MTS(P1), IPMS(P2) and RTS testing. The features tested are the data types defined in X.409, the various forms of length encoding and the use of primitive and constructor data elements. To increase the likelihood that the tests can be performed, the test cases wherever possible have been defined using the protocol elements associated with mandatory service elements.

Two categories of X.409 tests are identified:

- Decoding Tests

These tests are constructed by identifying X.409 features to be exercised and devising sets of correctly and incorrectly encoded test PDUs containing these features. The tests are performed by transmitting the test PDUs to the IUT and observing the local reaction of the implementation and/or any PDUs returned to the tester.

- Encoding Tests

These tests are constructed by identifying a set of user service requests that will generate PDUs whose encoding will exercise major X.409 features. The tester must check the validity of the coding of the resulting PDUs generated by the IUT.

The decoding tests allow the X.409 decoding features of an implementation to be fully exercised using valid and invalid test PDUs. Encoding tests only allow the valid behaviour of X.409 encoding to be checked.

8.3.2 Strategy for IPMS(P2) testing

Two categories of test are identified :

- IUT as originator
- IUT as recipient

With the IUT as originator, for each service element supported by the implementation, tests are performed by:

- Invoking the service.
- The tester checking the validity of the resulting PDUs.
- Where appropriate the tester returning valid and invalid response PDUs to the originator.

With the IUT as recipient, for each service element, tests are performed by:

- The tester sending valid and invalid PDUs for that service.
- Observing the local reaction of the UA.
- Checking the validity of any further PDUs generated by the UA.

In order to avoid unnecessary duplication of test cases, IPM service elements which are also MT service elements (for instance Delivery Notification) are listed in the MTS(P1) test suite in conjunction with the corresponding MT service elements, and not in the IPMS(P2) test suite.

It is assumed that the testing of the MT layer is done through a User Agent.

8.3.3 Strategy for MTS(P1) testing

When testing the operation of a MTS(P1) implementation five categories of tests are identified.

- IUT as originator
- IUT as recipient
- IUT as relay
- IUT as relay recipient
- IUT as recipient/originator

With the IUT as originator, for each service element supported by the implementation, tests are performed by:

- Invoking the service.
- Checking the validity of the resulting PDUs.

With the IUT as recipient, for each service element supported by the implementation, tests are performed by:

- The tester sending valid and invalid PDUs for that service.
- Observing the local reaction of the UA.
- Checking the validity of any further PDUs generated by the UA.

With the IUT as relay, for each service element tests are performed by:

- The tester sending valid and invalid PDUs for relaying.
- Checking the validity of the reaction of the IUT.

With the IUT as a relay recipient, for each service element tests are performed by:

- Sending a set of valid and invalid PDUs destined for more than one recipient. At least one of these recipients is attached to the IUT and a further recipient is attached to a remote MTA such that the IUT has to relay the message.
- Checking the validity of the reaction of the IUT as recipient.
- Checking that the PDUs that are relayed are not corrupted and are modified appropriately.

With the IUT as a recipient/originator, for each service element supported by the implementation, tests are performed by:

- Invoking the IUT to send a message to multiple recipients. At least one recipient will be attached to the IUT itself and a further recipient will be attached to a remote MTA.
- Checking the validity of the reaction of the IUT as recipient.
- Checking the validity of the PDUs transmitted by the IUT.

8.3.4 Strategy for RTS testing

The following testing phases are used:

(a) The connection/association establishment and negotiation phase.

The X.410 Recommendation allows different negotiable options and the negotiation phase is tested exhaustively using valid and invalid elements.

(b) The orderly release of the connection/association.

Only a few tests are required to check the correct implementation of the RTS release features.

(c) The data transfer phase with token exchange.

The data transfer tests check:

- The correct operation of data transfer using the negotiated values.
- The correct operation of token exchange.
- The correct confirmation of confirmed services.
- The correct reaction to invalid (eg non-negotiated) elements.

(d) Recovery

Tests are performed to check that an IUT can perform correct recovery after:

- User aborts
- Provider aborts
- Exception reports
- Not acknowledged checkpoints

9. Structure of test suites

The IPMS(P2) and MTS(P1) test suites have a common structure which differs from that of the RTS test suites.

9.1 Structure of IPMS(P2) and MTS(P1) test suites

The IPMS(P2) and MTS(P1) test suites consist of five groups of test cases:

(a) Initial Tests

The Initial Tests check mandatory features in a small number of test cases. They have been defined in order to check that the implementation correctly supports the main mandatory features and that it is sensible to continue with full conformance testing.

(b) X.409 Tests

The X.409 Tests check the IUT's encoding and decoding of protocol elements. Decoding tests are performed by transmitting test PDUs to the IUT. Encoding tests are performed by checking PDUs received from the IUT.

(c) Protocol Element tests

Protocol Element tests identify test purposes for every protocol element in the IPMS(P2)/MTS(P1) protocols. This is important in ensuring a full test coverage for the IPMS(P2)/MTS(P1) protocols. Many of these tests are necessarily performed as part of the Service Element tests.

(d) Service Element tests

Service Element tests check the capability of the IUT to support the service elements in X.400. Some of these tests are carried out in the initial tests and the X.409 tests. Service Element tests include both tests for specific service elements and tests for combinations of interdependent service elements.

(e) Additional Test

The Additional Test group checks features not covered in the other test groups.

As indicated in (a) to (e) above the number of test cases has been minimized by taking advantage of the fact that the performance of a given test case may cover more than one test purpose. Figure 6/X.403 shows how some of the test purposes identified in a particular test group may actually be achieved by test cases in another group.

Figure 6/X.403 Structure of IPMS(P2) and MTS(P1) test suites.

9.2 Structure of RTS test suites

The RTS test suite is made up of five groups of test cases:

- Association Establishment Tests
- Association Release Tests
- Data Transfer Tests
- Association Recovery Tests
- X.409 Tests

The Association Establishment Tests check the negotiation of the connection elements.

The Association Release Tests check the orderly release of associations.

The Data Transfer Tests check that data is transferred correctly in accordance with the values of the connection elements negotiated during association establishment.

The Association Recovery Tests check that the IUT can recover from breaks in connection both inside and outside activities.

The X.409 Tests check the IUT's encoding and decoding of Session Service User Data.

10. Information to be supplied by implementors

10.1 Protocol Implementation Conformance Statement (PICS)

The Protocol Implementation Conformance Statement (PICS) is information supplied by an implementor that specifies the protocol features implemented in a Message Handling System.

This information is used during conformance testing:

- To check that the protocol features that have been implemented are consistent with the conformance requirements, in terms of optional and mandatory features, of the X.400 series Recommendations.
- To select the originator tests to be executed. Recipient and relay tests will be performed to check the behaviour of the system even when it is requested to handle features that it does not implement.

PICS proformas for IPMS(P2), MTS(P1) and RTS are shown in Annex B, C and D. These proformas specify the information to be supplied by an implementor concerning:

- The services that are supported for origination, reception and relay functions.
- The protocol features that have been implemented in order to support the services.

The IPMS (P2) PICS explicitly includes the MTS (P1) service elements made available by the IPMS (P2). In order to avoid duplication with the MTS (P1) test suite, tests for such MTS (P1) service elements are not contained in the IPMS (P2) test suite. Where the testing of MTS (P1) is not performed using a UA, MTS (P1) tests may need to be repeated using a UA in order to ensure conformance to the IPMS (P2).

10.2 Protocol Implementation Extra Information for Testing (PIXIT)

The Protocol Implementation eXtra Information for Testing (PIXIT) is supplied by an implementor specifying information needed by a tester to execute a test suite.

The IPMS(P2), MTS(P1) and RTS test suites define the behaviour of the implementation in terms of abstract service primitives. In order to invoke and observe this behaviour during test execution the test operator must know how (if at all) these abstract service primitives can be invoked or observed at the real accessible user interface.

The IPMS(P2), MTS(P1) and RTS PIXIT proformas will list all the IUT upper layer abstract service primitives used in the test definitions and will ask the implementor to specify how these primitives can be invoked or observed (if at all).

11. Test Notation

11.1 Definitions

The notation used to define the MHS test specifications makes use of the following definitions:

(a) Test Suite

A set of test cases, possibly combined into nested test groups, necessary to perform conformance testing of an implementation.

The test suites do not imply an order of execution.

(b) Test Group

A set of related test cases. Test groups may be nested to provide a logical structuring of test cases.

(c) Test Case

Specifies the sequences of test events required to achieve the purpose of the test and to assign a verdict "pass", "fail" or "inconclusive".

(d) Test Event

An indivisible unit of test specification at the level of abstraction of the specification (e.g. sending or receiving a single PDU).

(e) User

A user-interface process or a computer application which makes use of an MHS.

11.2 Notation

The Conformance Test Suites for Message Handling Systems use the Tree and Tabular Combined Notation as described in Annexe A of this Recommendation.

Each test suite specification is defined in six sections:

1 Introduction

This contains an overview describing the scope of the tests and the structure of the test suite.

2 Summary of Test cases

This is a list of all tests giving the test identifier, the test reference and a short title for each test case in the test suite.

3 Declarations Part

Declares the names and types of all items to be used in defining the test cases.

4 Dynamic Part

This is the main body of the test suite and defines test cases in terms of trees of behaviour.

5 Constraints Part

Specifies the values of the ASPs and PDUs used in the Dynamic Part.

6 Cross references

Provides an index to all values used in the main body of the test suite.

12. Conformance Assessment Procedures

This Recommendation deals only with abstract test specifications for Message Handling Systems. It does not deal with the realization of these test specifications nor with their execution. This clause in the Recommendation is purely for information purposes to describe in general terms how real testing may be done.

12.1 Overview of the Procedure

The procedures needed to assess the conformance of an implementation include:

- The completion of the PICS and PIXIT proformas by the supplier of the implementation.
- The assessment of these documents.
- The selection and execution of test cases.
- The analysis of the results and the production of test reports.

Figure 7/X.403 The Conformance Assessment Procedure.

12.2 Analysis of PICS

The first phase in conformance assessment is to ensure that the features claimed to be supported by an IUT comply with appropriate conformance requirements. The conformance requirements for IPMS(P2), MTS(P1) and RTS implementations are defined in clause 7 of this document. This check is performed by analysing the

information in the PICS documents.

12.3 Test Case Selection

The tests to be performed are selected primarily on the basis of information in the PICS. For every supported feature claimed in the PICS the corresponding test cases in the test suites are selected and executed to check the correct implementation of these features under an extensive range of valid and invalid conditions.

For non-supported features, some recipient test cases shall be executed to explore the response of the IUT. Since in general the X.400 (1984) Series of Recommendations do not define the expected behaviour in these situations, these tests can be "passed" with almost any behaviour apart from catastrophic failure by the IUT.

Information in the PIXIT may also provide some constraints on the test cases that can be executed.

12.4 Execution of Tests

It is recommended that the testing of Message Handling Systems should be done in the order of RTS, then MTS(P1) and then IPMS(P2) testing.

However the order of test cases in the test suites does not imply an order of execution. Apart from the general recommendation that for IPMS(P2)/MTS(P1) the Initial Test Group should be executed first, the order of execution of tests can be determined by the test operators taking into account their test environment and test tools.