The ATM Forum
Technical Committee

# Interoperability Abstract Test Suite for the ATM Layer

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**Interoperability Abstract Test Suite for the ATM Layer**

Version 1.0

April, 1995

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# Table of Contents

1. Introduction ..... 1
   1.1 Scope ..... 1
   1.2 References ..... 1
   1.3 Abbreviations ..... 2

2. Test Realization ..... 2

3. Test Configuration ..... 3

4. Interoperability Interface Tests ..... 8
   4.1 Test Case Index ..... 8
   4.2 Test Cases Dynamic Behavior ..... 9

5. Interoperability Interface Load Tests ..... 23
   5.1 Test Case Index ..... 23
   5.2 Test Cases Dynamic Behavior ..... 23

# 1. Introduction

This document provides an interoperability abstract test suite for the ATM layer. It belongs to a set of test documents supplied by the ATM Forum that cover the testing areas conformance, performance and interoperability testing. The document "Introduction to ATM Forum Test Specification" [2] provides an introduction to the different testing areas and should be consulted prior to using this test suite.

## 1.1 Scope

This document provides an interoperability abstract test suite for the ATM layer. It includes sample test cases that address interoperability at different levels. These levels include:

- Basic Connectivity: These tests are applied when both SUTs meet or claim conformance to the ATM Forum UNI specifications [1]. Some of these tests may be eliminated if thorough dynamic conformance testing has taken place and the results have been analyzed prior to interoperability testing.
- Support of Optional Features/Functions: These tests are applied when one or both of the SUTs support a feature or function that was specified as an option. They are not applied when neither of the SUTs support that feature or function.

If one or both of the SUTs support a proprietary feature, additional test cases will be required to address its effect on interoperability. These test cases can be added as required but are not part of this test suite.

Systems under test (SUTs) are ATM switches connected via UNI as defined in [1] section 1.6.

## 1.2 References

[1] ATM User-Network Interface Specification, Version 3.0, ATM Forum, September 1993.

[2] Introduction to ATM Forum Test Specifications, ATM Forum, AF-TEST-0022.000, November 1994

## 1.3 Abbreviations

| | |
|---|---|
| AIS | Alarm Indication Signal |
| ATM | Asynchronous Transfer Mode |
| ATS | Abstract Test Suite |
| CBR | Constant Bit Rate |
| CLP | Cell Loss Priority |
| FERF | Far End Receive Failure |
| GFC | Generic Flow Control |
| IOP | Interoperability |
| PT | Payload Type |
| QoS | Quality of Service |
| SUT | System Under Test |
| VC | Virtual Channel |
| VCC | Virtual Channel Connection |
| VCI | Virtual Channel Identifier |
| VP | Virtual Path |
| VPC | Virtual Path Connection |
| VPI | Virtual Path Identifier |

# 2. Test Realization

The realization of each test case within this test suite shall be the responsibility of the test laboratory. The test realization shall adhere to the following condition:

- the realization of a test case shall meet all of the requirements and objectives of the test case as specified in the test purpose of each test case.

Where appropriate test cases using bidirectional connections may be adapted to unidirectional connections.

# 3. Test Configuration

The general test set-up for the interoperability test of two ATM switches (the SUTs) is shown in Figure 3.1. In general, one or more VPC or VCC are established between the pair of ATM Cell Generator/Analyzer through SUT A and SUT B. VPC and VCC may be established by management plane, by signalling or by any other means. The establishment of VPCs or VCCs as such is not part of the abstract test suite. The Cell Generator/Analyzer connected to SUT A is referred to as Tester A and the one connected to SUT B as Tester B. They serve as the source and/or sink of ATM cells. The testers may be part of a single physical unit. To examine the cells being transmitted between the components shown, ATM cell monitors may be placed at the points marked as monitor points A, B, and C.

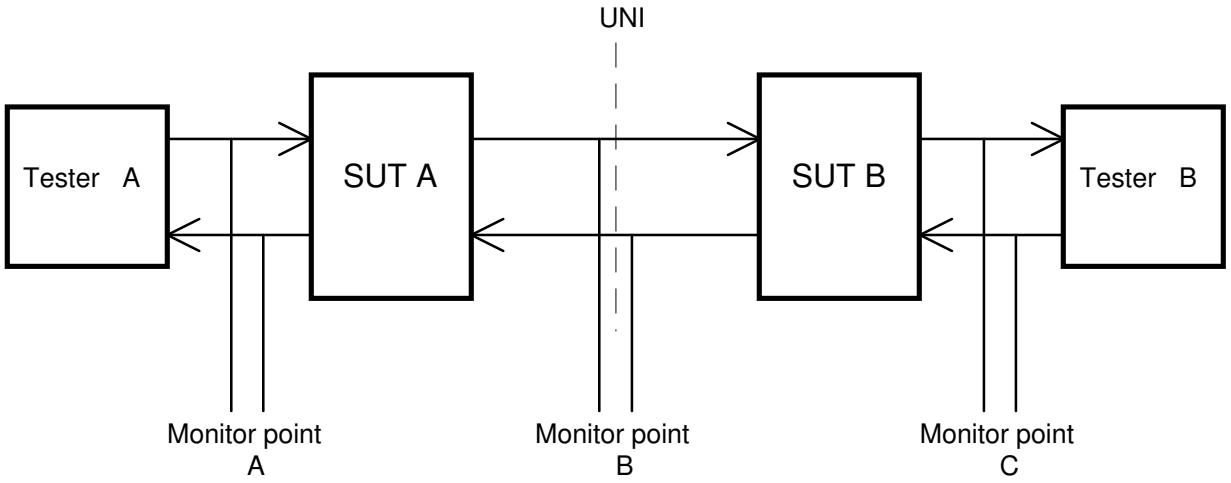


Figure 3.1: Generic ATM Layer Test Configuration

In the test configurations shown on the following pages, only the relevant components are shown. Other parts of the configuration that are needed (e.g. management access for the configuration of the switch or to read results), but are for reasons of clarity omitted. Not all of the monitoring points shown are required. The required monitoring points are stated in the text of the pass/fail criteria; others may be needed only for trouble isolation. Note: Monitor points may be included in the tester.

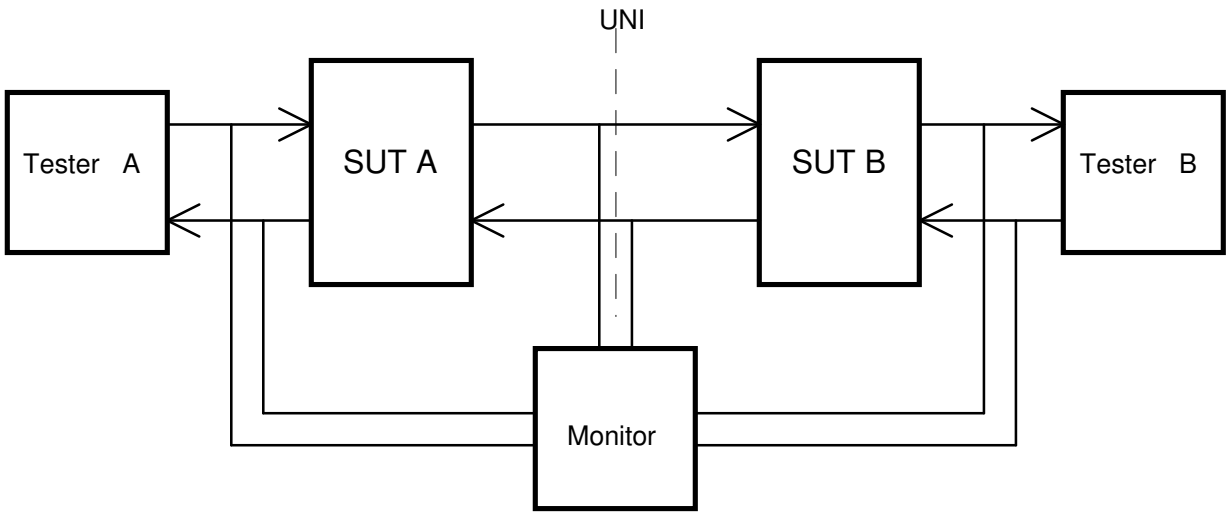


Figure 3.2: Test Configuration #1

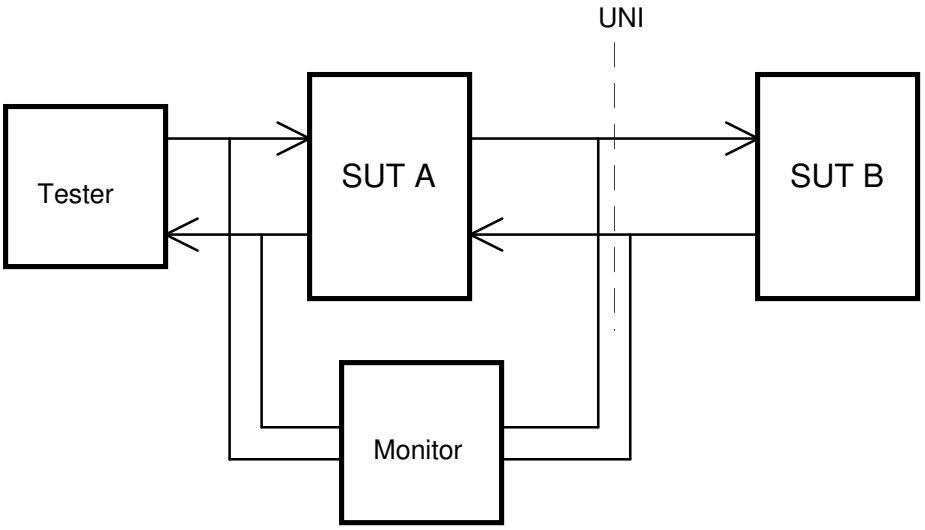


Figure 3.3: Test Configuration #2
(Note: Configuration currently not used)

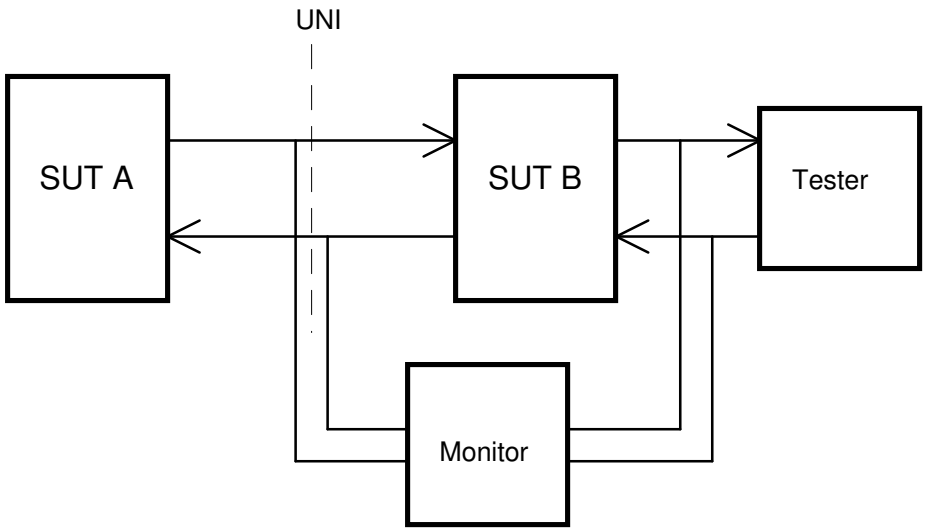


Figure 3.4: Test Configuration #3
(Note: Configuration currently not used)

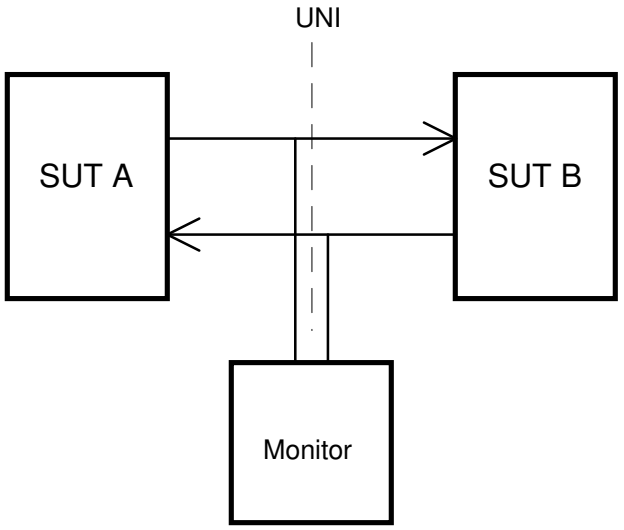


Figure 3.5: Test Configuration #4

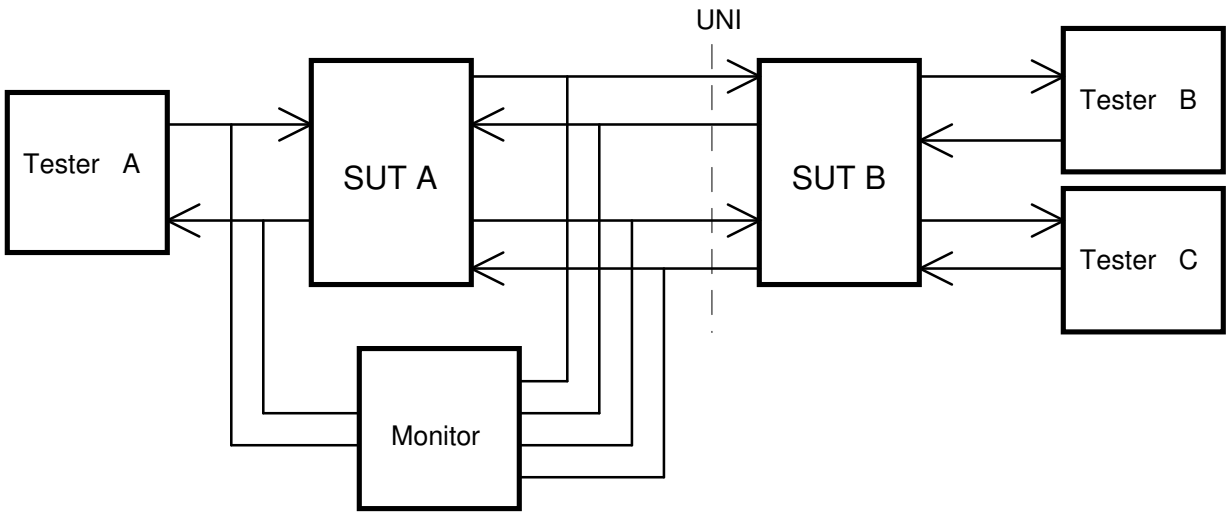


Figure 3.6: Test Configuration #5
(Note: the VPC or VCC created may be on the same or different physical link)

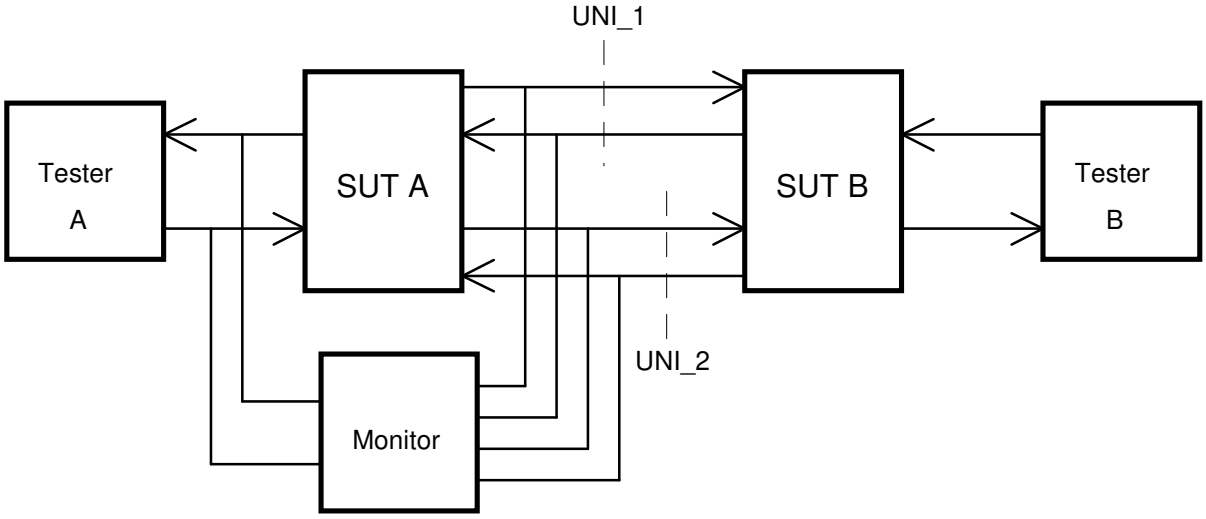


Figure 3.7: Test Configuration #6
(Note: UNI_1.... UNI_2 are located on separate physical links)

Most of the test cases are based on cell streams introduced by Tester A and/or B. These cell streams are called Test Traffic. The following two types of Test Traffic are used:

L (Low): No other traffic (except the test traffic and the associated OAM flows) shall be allowed in the SUTs.

The test traffic load generated shall be Constant Bit Rate (CBR), shall not exceed 10% of the allocated bandwidth and shall never exceed the data rate of the links the test traffic has to cross.

The UPC shall not be activated, or the test traffic shall not be discarded by UPC action (e.g. by choosing an appropriate test traffic pattern and load)

H (High): No other traffic (except the test traffic and the associated OAM flows) shall be allowed in the SUTs.

The test traffic load generated shall be CBR, shall not exceed 90% of the allocated bandwidth and shall never exceed the data rate of the links the test traffic has to cross.

The UPC shall not be activated, or the test traffic shall not be discarded by UPC action (e.g. by choosing an appropriate test traffic pattern and load)

# 4. Interoperability Interface Tests

## 4.1 Test Case Index

| No | Test Case ID | Test case name | UNI 3.0 Reference | Execute test case if both SUTs implement | | |
|---|---|---|---|---|---|---|
| | | | | VCC | VPC | VCC & VPC |
| 1 | ATM/UCell/1 | No assigned cells on links where no virtual connection is established | 3.4.2 | x | x | x |
| 2 | ATM/Cell Relay/1 | Point-to-point VPC | 3.1 | | x | x |
| 3 | ATM/Cell Relay/2 | Point-to-point VCC | 3.1 | x | | x |
| 4 | ATM/UCell/2 | Unassigned cells in virtual connections | 3.4.2 | x | x | x |
| 5 | ATM/Cell Relay/3 | Point-to-multipoint VCC | 3.1 | x | | x |
| 6 | ATM/Cell Relay/4 | Point-to-multipoint VPC | 3.1 | | x | x |
| 7 | ATM/Cell Relay/5 | Interoperability in the "uncontrolled access" mode, VPC | 3.3 | | x | x |
| 8 | ATM/Cell Relay/6 | Interoperability in the "uncontrolled access" mode, VCC | 3.3 | x | | x |
| 9 | ATM/VPI/1 | VPI range test for VPC | 3.3 | | x | x |
| 10 | ATM/VCI/1 | VPI/VCI range test for VCC | 3.3 | x | | x |
| 11 | ATM/PT/1 | PT Field Testing (PT='101'), VPC | 3.4.4 | | x | x |
| 12 | ATM/PT/2 | PT Field Testing (PT='101'), VCC | 3.4.4 | x | | x |
| 13 | ATM/PT/3 | PT Field Testing (PT='110'), VPC | 3.4.4 | | x | x |
| 14 | ATM/PT/4 | PT Field Testing (PT='110'), VCC | 3.4.4 | x | | x |
| 15 | ATM/PT/5 | PT Field Testing (PT='111'), VPC | 3.4.4 | | x | x |
| 16 | ATM/PT/6 | PT Field Testing (PT='111'), VCC | 3.4.4 | x | | x |
| 17 | ATM/PT/7 | User Data PT, VPC | 3.3 | | x | x |
| 18 | ATM/PT/8 | User Data PT, VCC | 3.3 | x | | x |
| 19 | ATM/CLP/1 | Cell Loss Priority, VPC | 3.3 | | x | x |
| 20 | ATM/CLP/2 | Cell Loss Priority, VCC | 3.3 | x | | x |
| 21 | ATM/OAMF4_A/1 | OAM-F4-End-AIS | 3.5.2 | | x | x |
| 22 | ATM/OAMF4_A/2 | OAM-F4-End-AIS generation | 3.5.2 | | x | x |
| 23 | ATM/OAMF4_F/1 | OAM-F4-End-FERF | 3.5.2 | | x | x |
| 24 | ATM/OAMF4_F/2 | OAM-F4-End-FERF generation | 3.5.2 | | x | x |

| No | Test Case ID | Test case name | UNI 3.0 Reference | Execute test case if both SUTs implement | | |
|---|---|---|---|---|---|---|
| | | | | VCC | VPC | VCC & VPC |
| 25 | ATM/OAMF4_L/1 | OAM-F4-End-Loopback | 3.5.2 | | x | x |
| 26 | ATM/OAMF4_L/2 | OAM-F4-End-Loopback, SUT B is VPC end point | 3.5.3.2 | | x | x |
| 27 | ATM/OAMF4_L/3 | Faulty OAM-F4-End-Loopback, SUT B is VPC end point | 3.5.3.2 | | x | x |
| 28 | ATM/OAMF4_L/4 | OAM-F4-Segment-Loopback | 3.5.3.2 | | x | x |
| 29 | ATM/OAMF5_A/1 | OAM-F5-End-AIS | 3.5.2 | x | | x |
| 30 | ATM/OAMF5_F/1 | OAM-F5-End-FERF | 3.5.2 | x | | x |
| 31 | ATM/OAMF5_L/1 | OAM-F5-End-Loopback | 3.5.2 | x | | x |
| 32 | ATM/OAMF5_L/2 | OAM-F5-Segment-Loopback | 3.5.3.2 | x | | x |

## 4.2 Test Cases Dynamic Behavior

**1. Test Case ID: ATM/UCell/1**

Test Case Name: No assigned cells on links where no virtual connection is established.
Test Purpose: To verify that the two SUTs connected to each other only exchange unassigned or idle cells.
Pre-requisite: Always run.
Reference: [1], Section 3.4.2
Test Configuration: #4

Test Set-up:
1. Connect the two SUTs.
2. No VPC or VCC may be established.

Test Procedure:
1. Monitor the UNI between SUT A and B.

Verdict Criteria:
No assigned cells (only idle or unassigned cells) shall be observed at the UNI.

**2. Test Case ID: ATM/Cell Relay/1**

Test Case Name: Point-to-point VPC.
Test Purpose: To verify point-to-point VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.1
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VP connection (VPC) between Tester A and B.

Test Procedure:
1. For the given VPC, select 3 or more VCCs.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and for each VCC.
3. Testers A and B monitor the received cell stream.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC in the correct VCCs.

**3. Test Case ID: ATM/Cell Relay/2**

Test Case Name: Point-to-point VCC.
Test Purpose: To verify point-to-point VCC.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.1
Test Configuration: #1

Test Set-up:
1. Establish 3 or more bidirectional VC connections (VCCs) between Testers A and B.

Test Procedure:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and for each VCC.
2. Testers A and B monitor the received cell stream.

Verdict Criteria:
All cells generated at the originating end points shall appear at the terminating end points in the correct VCCs.

**4. Test Case ID: ATM/UCell/2**

Test Case Name: Unassigned cells in virtual connections.
Test Purpose: To verify that unassigned cells are included at the sending side and discarded at the receiving side by both SUTs.
Pre-requisite: Always run.
Reference: [1], Section 3.4.2
Test Configuration: #1

Test Set-up:
1. Establish at least one bidirectional VPC or VCC between Testers A and B.
2. Testers A and B generate independent cell streams of test traffic type L for the virtual connection.

Test Procedure:
1. Stop Testers A and B from generating cells, so that only OAM F4 and F5 cells are exchanged by the two SUTs.
2. Testers A and B monitor the cells.

Verdict Criteria:
Verify that neither SUT A or B detect any assigned cells (besides OAM F4 and F5 cells) which will be transmitted as misdelivered cells to Testers A or B.

**5. Test Case ID: ATM/Cell Relay/3**

Test Case Name: Point-to-multipoint VCC.
Test Purpose: To verify point-to-multipoint VCC.
Pre-requisite: Run if one or both SUTs implement VC point-to-multipoint.
Reference: [1], Section 3.1
Test Configuration: #5

Test Set-up:
1. Establish on SUT A one unidirectional root VCC with at least two leaves.

Test Procedure:
1. Tester A generates a cell stream consisting of test traffic type L and inserts it at the root.
2. All leaf end points are monitored.
3. Repeat the procedure after exchanging position of SUT A and SUT B (if applicable).

Verdict Criteria:
All cells generated at the originating root VCC shall appear at each of the leaves.

**6. Test Case ID: ATM/Cell Relay/4**

Test Case Name: Point-to-multipoint VPC.
Test Purpose: To verify point-to-multipoint VPC.
Pre-requisite: Run if one or both SUTs implement VP point-to-multipoint.
Reference: [1], Section 3.1
Test Configuration: #5

Test Set-up:
1. Establish on SUT A one unidirectional root VPC with at least two leaves.

Test Procedure:
1. Tester A generates a cell stream consisting of test traffic type L and inserts it at the root.
2. All leaf end points are monitored.
3. Repeat the procedure after exchanging position of SUT A and SUT B (if applicable).

Verdict Criteria:
All cells generated at the originating root VPC shall appear at each of the leaves.

**7. Test Case ID: ATM/Cell Relay/5**

Test Case Name: Interoperability in the "uncontrolled access" mode, VPC.
Test Purpose: To verify interoperability in the "uncontrolled access" mode on VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish at least one bidirectional VPC between Testers A and B.

Test Procedure:
1. For each VPC, select 3 or more VCCs.
2. Tester A generates a cell stream consisting with GFC field set to 0 of test traffic type H for each VCC.
3. Tester B monitors the received cell stream.
4. Repeat this test with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
All cells inserted at the originating end points shall appear in the terminating end points of the VPC in the correct VCCs.

**8. Test Case ID: ATM/Cell Relay/6**

Test Case Name: Interoperability in the "uncontrolled access" mode, VCC.
Test Purpose: To verify interoperability in the "uncontrolled access" mode on VCC.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish at least 3 bidirectional VCCs between Testers A and B.

Test Procedure:
1. Tester A generates a cell stream consisting with GFC field set to 0 of test traffic type H for each VCC.
2. Tester B monitors the received cell stream.
3. Repeat this test with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
All cells inserted at the originating end points shall appear in the terminating end points of the VCCs.

**9. Test Case ID: ATM/VPI/1**

Test Case Name: VPI range test for VPC.
Test Purpose: To verify that two SUTs can communicate over the range of VPI values common to both SUTs.
Pre -requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Set up at least three bidirectional VPCs between Tester A and B. The VPI values used must include the minimum and the maximum value of all possible VPI and at least one value in between.
   Note: Since the maximum number of possible VPI values supported by SUT A and SUT B are not necessarily the same, the lower number has to be used.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and VPCs representing the range of VPI values.
2. Testers A and B monitor the received cell streams.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPCs.

**10. Test Case ID: ATM/VCI/1**

Test Case Name: VPI/VCI range test for VCC.
Test Purpose: To verify that two SUTs can communicate over the range of VPI/VCI values common to both SUTs.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Set up at least three bidirectional VCCs between Tester A and B. The VPI/VCI values used must include the minimum and the maximum value of all possible VPI/VCI and at least one value in between.
   Note: Since the maximum number of possible VPI/VCI values provided by SUT A and SUT B are not necessarily the same, the lower number has to be used.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and VCCs representing the range of VPI/VCI values.
2. Testers A and B monitor the received cell streams.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCCs.

**11. Test Case ID: ATM/PT/1**

Test Case Name: PT Field Testing (PT='101'), VPC.
Test Purpose: To verify the transparency of OAM F5 flow on VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.
2. Testers A and B send OAM F5 flow on the VPC (PT field equal to '101').
3. Testers A and B monitor the OAM F5 flow.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPCs (including all the OAM F5 flow with PT field equal to '101') .

**12. Test Case ID: ATM/PT/2**

Test Case Name: PT Field Testing (PT='101'), VCC.
Test Purpose: To verify the transparency of OAM F5 flow on VCC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.
2. Testers A and B send OAM F5 flow on the VCC (PT field equal to '101').
3. Testers A and B monitor the OAM F5 flow.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCCs (including all the OAM F5 flow with PT field equal to '101') .

**13. Test Case ID: ATM/PT/3**

Test Case Name: PT Field Testing (PT='110'), VPC.
Test Purpose: To verify that SUTs pass cells with PT='110' transparently on VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.
2. Testers A and B send cells on the VPC with PT field equal to '110'.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC (including cells with PT field equal to '110').

**14. Test Case ID: ATM/PT/4**

Test Case Name: PT Field Testing (PT='110'), VCC.
Test Purpose: To verify that SUTs pass cells with PT='110' transparently on VCC.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.
2. Testers A and B send cells on the VCC with PT field equal to '110'.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCC (including cells with PT field equal to '110').

**15. Test Case ID: ATM/PT/5**

Test Case Name: PT Field Testing (PT='111'), VPC.
Test Purpose: To verify that SUTs pass any cells with the undefined PT value (PT='111') transparently on VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.
2. Testers A and B send cells on the VPC with PT field equal to '111'.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC (including cells with PT field equal to '111') .

**16. Test Case ID: ATM/PT/6**

Test Case Name: PT Field Testing (PT='111'), VCC.
Test Purpose: To verify that SUTs pass any cells with the undefined PT value (PT='111') transparently on VCC.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.4.4
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.

Test Procedures:
1. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.
2. Testers A and B send cells on the VCC with PT field equal to '111'.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCC (including cells with PT field equal to '111') .

**17. Test Case ID: ATM/PT/7**

Test Case Name: User Data PT, VPC.
Test Purpose: To verify the transparency in the use of the payload type field indicating user data on VPC.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.

Test Procedure:
1. Testers A and B generate independent cell streams with GFC field set to 0 of test traffic type H for the VPC.
2. Testers A and B send cells with the values of the Payload Type field of '0XX' (PT = '000', '001', '010', and '011').
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC (including cells with PT field equal to '0XX') .

**18. Test Case ID: ATM/PT/8**

Test Case Name: User Data PT, VCC.
Test Purpose: To verify the transparency in the use of the payload type field indicating user data on VCC.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.

Test Procedure:
1. Testers A and B generate independent cell streams with GFC field set to 0 of test traffic type H for the VCC.
2. Testers A and B send cells with the values of the Payload Type field of '0XX' (PT = '000', '001', '010', and '011').
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCC (including cells with PT field equal to '0XX') .

**19. Test Case ID: ATM/CLP/1**

Test Case Name: Cell Loss Priority, VPC.
Test Purpose: To verify that SUTs pass cells under low load condition on VPC independently of the Cell Loss Priority (CLP) field.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.

Test Procedure:
1. Testers A and B generate independent cell streams of test traffic type L for the VPC.
2. Testers A and B send cells with both values of the CLP field.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC regardless of the value of the CLP field.

**20. Test Case ID: ATM/CLP/2**

Test Case Name: Cell Loss Priority, VCC.
Test Purpose: To verify that SUTs pass cells under low load condition on VCC independently of the Cell Loss Priority (CLP) field.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.3
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.

Test Procedure:
1. Testers A and B generate independent cell streams of test traffic type L for the VCC.
2. Testers A and B send cells with both values of the CLP field.
3. Testers A and B monitor the cells.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCC regardless of the value of the CLP field.

**21. Test Case ID: ATM/OAMF4_A/1**

Test Case Name: OAM-F4-End-AIS.
Test Purpose: To verify that an intermediate SUT will pass the end-to-end OAM F4-AIS cells transparently.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.5.2
Test Configuration: #1

Test Set-up:
1. Set up one bidirectional VPC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.

Test Procedure:
1. Tester B generates OAM F4-AIS cells for the VPC of approx. 1 cell per second.
2. Monitor the OAM F4-AIS cells that flow back through SUT B and SUT A to Tester A.

Verdict Criteria:
SUT A and SUT B shall pass all OAM F4-AIS cells transparently to Tester A.

**22. Test Case ID: ATM/OAMF4_A/2**

Test Case Name: OAM-F4-End-AIS generation.
Test Purpose: To verify that intermediate SUTs will generate end-to-end OAM F4-AIS cells.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.5.2
Test Configuration: #6

Test Set-up:
1. Set up for each physical link (UNI_1, UNI_2) at least two bidirectional VPCs between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and for each VPC.

Test Procedure:
1. Disconnect from SUTA the physical outgoing link UNI_1.
2. Monitor the OAM F4-AIS cells that flow from SUT B to Tester B.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:
SUT B shall generate multiple OAM F4-AIS cells on each of the VPCs carried by the disconnected physical link.
VPCs carried by the not disconnected physical link must not have any OAM F4-AIS cells.

**23. Test Case ID: ATM/OAMF4_F/1**

Test Case Name: OAM-F4-End-FERF.
Test Purpose: To verify that an intermediate SUT will pass the end-to-end OAM F4-FERF cells transparently.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.5.2
Test Configuration: #1

Test Set-up:
1. Set up one bidirectional VPC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.

Test Procedure:
1. Tester B generates OAM F4-FERF cells for the VPC of approx. 1 cell per second.
2. Monitor the OAM F4-FERF cells that flow back through SUT B and SUT A to Tester A.

Verdict Criteria:
SUT A and SUT B shall pass all OAM F4-FERF cells transparently to Tester A.

**24. Test Case ID: ATM/OAMF4_F/2**

Test Case Name: OAM-F4-End-FERF generation.
Test Purpose: To verify that an end SUT will generate OAM F4-FERF cells.
Pre-requisite: Run if one of the SUT (SUT B) can be configured as a VP termination and the other (SUT A) implement VPC.
Reference: [1], Section 3.5.2
Test Configuration: #6

Test Set-up:
1. Set up for each physical link (UNI_1, UNI_2) at least two bidirectional VPCs between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and for each VPC.

Test Procedure:
1. Disconnect from SUT A the physical outgoing link UNI_1.
2. Monitor the OAM F4-FERF cells that are generated by the SUT B to SUT A and Tester A.
3. Repeat the procedures after swapping the SUTs if appropriate.

Verdict Criteria:
SUT B shall generate OAM F4-FERF cells in the VPC carried by the disconnected physical link and SUT A should pass the OAM F4-FERF cells transparently.
VPCs carried by the not disconnected physical link must not have any OAM F4-FERF cells.

**25. Test Case ID: ATM/OAMF4_L/1**

Test Case Name: OAM-F4-End-Loopback.
Test Purpose: To verify that intermediate SUTs will pass end-to-end OAM F4 cells with the loopback function transparently.
Pre-requisite: Run if both SUTs implement VPC.
Reference: [1], Section 3.5.2
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.

Test Procedure:
1. For the given VPC Tester A generates end-to-end OAM F4 loopback cells at a rate of approx. 1 cell per second.
2. Testers A and B monitor the received cell stream. Tester B shall not loopback the OAM F4 loopback cells.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC.
No OAM F4 cell shall arrive at Tester A.

**26. Test Case ID: ATM/OAMF4_L/2**

Test Case Name: OAM-F4-End-Loopback, SUT B is VPC end point.
Test Purpose: To verify that the terminating end point of a VPC will decrement the loopback indication field and will loopback without modifying the correlation tag.
Pre-requisite: Run if one of the SUT (SUT B) can be configured as a VP termination and the other (SUT) A implement VPC.
Reference: [1], Section 3.5.3.2
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Tester A and SUT B, terminating at SUT B.
2. In the VPC establish one VCC between Testers A and B.
3. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.

Test Procedure:
1. For the given VPC Tester A generates end-to-end OAM F4 loopback cells at a rate of approx. 1 cell per second with loopback indication field of '00000001'.
2. Testers A and B monitor the received cell stream.
3. If SUT A can be configured as VP termination: Repeat the procedures after swapping the SUTs.

Verdict Criteria:
All not-OAM-F4 cells inserted at the originating end point shall appear in the terminating end point of the VCC.
Tester A shall receive the end-to-end OAM F4 loopback cells from SUT B. Loopback indication field shall be set to zero and the correlation tag shall not be modified.

**27. Test Case ID: ATM/OAMF4_L/3**

Test Case Name: Faulty OAM-F4-End-Loopback, SUT B is VPC end point.
Test Purpose: To verify that the terminating end point of a VPC will delete loopback cells with loopback indication values other than '00000001'.
Pre-requisite: Run if one of the SUTs (SUT B) can be configured as a VP termination and the other (SUT A) implement VPC.
Reference: [1], Section 3.5.3.2
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VPC between Tester A and SUT B, terminating at SUT B.
2. In the VPC establish one VCC between Testers A and B.
3. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.

Test Procedure:
1. For the given VPC Tester A generates end-to-end OAM F4 loopback cells at a rate of approx. 1 cell per second with loopback indication field other than '00000001' (at least the value '00000000' shall be checked).
2. Testers A and B monitor the received cell stream.
3. If SUT A can be configured as VP termination: Repeat the procedures after swapping the SUTs.

Verdict Criteria:
All cells, but not any end-to-end OAM F4 loopback cells, inserted at the originating end point shall appear in the terminating end point of the VCC and the VPC (Tester A).

**28. Test Case ID: ATM/OAMF4_L/4**

Test Case Name: OAM-F4-Segment-Loopback.
Test Purpose: To verify that the end point SUT of a VP segment will decrement the loopback indication field and will loopback without modifying the received correlation tag.
Pre-requisite: Run if the SUTs support segment OAM F4 loopback cells.
Reference: [1], Section 3.5.3.2
Test Configuration: #1

Test Set-Up:
1. Establish one bidirectional VPC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VPC.

Test Procedure:
1. Testers A and B monitor the received cell stream.
2. Stimulate SUT A to generate OAM F4 segment loopback cells, that will be looped back at SUT B.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VPC. Testers A and B shall not receive any OAM F4 loopback cell.
SUT B shall respond to the segment OAM F4 loopback cell that is carried on VCI = 3 (with given VPC) by sending back SUT A loopback cells with the loopback indication field set to zero. SUT A shall delete the loopback cell. SUT B shall not modify the correlation tag.

**29. Test Case ID: ATM/OAMF5_A/1**

Test Case Name: OAM-F5-End-AIS.
Test Purpose: To verify that intermediate SUTs will generate end-to-end OAM F5-AIS cells.
Pre-requisite: Run only if supported.
Reference: [1], Section 3.5.2
Test Configuration: #6

Test Set-up:
1. Set up for each physical link (UNI_1, UNI_2) at least two bidirectional VCCs between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction and for each VCC.

Test Procedure:
1. Disconnect from SUT A the physical outgoing link UNI_1.
2. Monitor the OAM F5-AIS cells from SUT B to Tester B.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:
SUT B shall generate multiple OAM F5-AIS cells on each VCC carried by the disconnected physical link. VCCs carried by the not disconnected physical link must not have any OAM F5-AIS cells.

**30. Test Case ID: ATM/OAMF5_F/1**

Test Case Name: OAM-F5-End-FERF.
Test Purpose: To verify that an intermediate SUT will pass end-to-end OAM F5-FERF cells transparently.
Pre-requisite: Run only if supported.
Reference: [1], Section 3.5.2
Test Configuration: #1

Test Set-up:
1. Set up one bidirectional VCC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.

Test Procedure:
1. Tester B generates OAM F5-FERF cells for the VCC of approx. 1 cell per second.
2. Monitor the OAM F5-FERF cells that flow back through SUT B and SUT A to Tester A.

Verdict Criteria:
SUT A and SUT B shall pass all OAM F5-FERF cells transparently to Tester A.

**31. Test Case ID: ATM/OAMF5_L/1**

Test Case Name: OAM-F5-End-Loopback.
Test Purpose: To verify that an intermediate SUT will pass end-to-end OAM F5 cells with the loopback function.
Pre-requisite: Run if both SUTs implement VCC.
Reference: [1], Section 3.5.2
Test Configuration: #1

Test Set-up:
1. Establish one bidirectional VCC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.

Test Procedure:
1. For the given VCC Tester A generates end-to-end OAM F5 loopback cells at a rate of approx. 1 cell per second.
2. Testers A and B monitor the received cell stream. Tester B shall not loopback the OAM F5 loopback cells.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:
All cells inserted at the originating end point shall appear in the terminating end point of the VCC.
No OAM F5 cell shall arrive at Tester A.

**32. Test Case ID: ATM/OAMF5_L/2**

Test Case Name: OAM-F5-Segment-Loopback.
Test Purpose: To verify that the end points of a VC segment will decrement the loopback indication field and will loopback without modifying the correlation tag.
Pre-requisite: Run if SUTs support the segment OAM F5 loopback cells.
Reference: [1], Section 3.5.3.2
Test Configuration: #1

Test Set-up:

1. Establish one bidirectional VCC between Testers A and B.
2. Testers A and B generate independent cell streams consisting of test traffic type L for each direction of the VCC.

Test Procedures:

1. Testers A and B monitor the received cell stream.
2. Stimulate SUT A to generate OAM F5 segment loopback cells, that will be looped back at SUT B.
3. Repeat the procedures after swapping the SUTs.

Verdict Criteria:

All cells inserted at the originating end point shall appear in the terminating end point of the VCC.
Testers A and B shall not receive any OAM F5 loopback cell.
SUT B shall respond to the segment OAM F5 loopback cells with the VPI/VCI values used in the test with PT ='100' and the loopback indication field set to zero. SUT A shall delete the loopback cell. SUT B shall not modify the correlation tag it received.

# 5. Interoperability Interface Load Tests

## 5.1 Test Case Index

| No | Test Case ID | Test case name | Execute test case if both SUTs implement | | |
|---|---|---|---|---|---|
| | | | VCC | VPC | VCC & VPC |
| 33 | SET-UP_UD | Maximum supported cell rate for unidirectional cell stream at one UNI | x | x | x |
| 34 | SET-UP_BD | Maximum supported cell rate for bidirectional cell stream at one UNI | x | x | x |
| 35 | ATM/LT/1 | Unidirectional traffic test for VPC | | x | x |
| 36 | ATM/LT/2 | Unidirectional traffic test for VCC | x | | x |
| 37 | ATM/LT/3 | Simultaneous bidirectional traffic test on VPC | | x | x |
| 38 | ATM/LT/4 | Simultaneous bidirectional traffic test on VCC | x | | x |
| 39 | ATM/LT/5 | Handling of multiple VPCs | | x | x |
| 40 | ATM/LT/6 | Handling of multiple VCCs | x | | x |
| 41 | ATM/LT/7 | Payload pattern test on VPCs | | x | x |
| 42 | ATM/LT/8 | Payload pattern test on VCCs | x | | x |
| 43 | ATM/LT/9 | Endurance test on VPCs | | x | x |
| 44 | ATM/LT/10 | Endurance test on VCCs | x | | x |

## 5.2 Test Cases Dynamic Behavior

**33. Test Case ID: SET-UP_UD**

Test Name: Maximum supported cell rate for unidirectional cell stream at one UNI.
Test Purpose: To determine the maximum cell rate that can be supported by both SUTs interconnected by an UNI.
Pre-requisite: Always run previously to test cases ATM/LT/1, 2, 5, 6, 7 and 8.
Reference: None
Test Configuration: #1

Test Set-up:

1. Establish required unidirectional VPCs or VCCs between Testers A and B.
2. No other traffic (except test traffic) shall be allowed in the SUTs.
3. Configure Tester A to generate cells at 100% of the cell rate across the UNI (the interconnection of SUT A and SUT B).
4. The test traffic of Tester A shall not be discarded by UPC action of the SUT A, e.g. by choosing an appropriate test traffic pattern and load.
   *[The influence of OAM F4 and F5 flows needs further investigation]*

Test Procedure:

1. Observe the cell loss at cell analyzer B for at least receiving 1'000'000 cells.
2. If no cell loss can be observed, the current value is taken as the cell rate both SUTs can support across the UNI and is used for test cases ATM/LT/1, 2, 5, 6, 7 and 8.
3. If cell loss is observed, decrease the cell rate transmitted by cell generator A and start with step 1.
   *[decreasing algorithm for further study]*

**34. Test Case ID: SET-UP_BD**

Test Name: Maximum supported cell rate for bidirectional cell stream at one UNI.
Test Purpose: To determine the maximum cell rate that can be supported by both SUTs interconnected by an UNI.
Pre-requisite: Always run previously to test cases ATM/LT/3, 4, 9 and 10.
Reference: None
Test Configuration: #1

Test Set-up:

1. Establish required bidirectional VPCs or VCCs between Testers A and B.
2. No other traffic (except test traffic) shall be allowed in the SUTs.
3. Configure Testers A and B to generate cells at 100% of the cell rate across the UNI (the interconnection of SUT A and SUT B).
4. The test traffic of Tester A (B) shall not be discarded by UPC action of the SUT A (SUT B), e.g. by choosing an appropriate test traffic pattern and load.
   *[The influence of OAM F4 and F5 flows needs further investigation]*
5. The cell rate across the UNI shall be equal in both direction in terms of rate and traffic pattern.

Test Procedure:

1. Observe the cell loss at Testers A and B for at least receiving 1'000'000 cells.
2. If no cell loss can be observed in both directions, the current value is taken as the cell rate both SUTs can support across the UNI and is used for test cases ATM/LT/3, 4, 9 and 10.
3. If cell loss is observed, decrease the cell rate transmitted by Testers A and B in parallel and start with step 1.
   *[decreasing algorithm and traffic pattern for further study]*

**35. Test Case ID: ATM/LT/1**

Test Case Name: Unidirectional traffic test for VPC.
Test Purpose: To verify the ability to transfer a cell stream in one direction at different cell rates.
Pre-requisite: Run if both SUTs implement VPC.
Reference: None
Test Configuration: #1

Test Set-up:

1. Establish at least one unidirectional VPC between Testers A and B.
2. Test case SET-UP_UD.

Test Procedure:

1. Tester A generates a cell stream for each VPC.
2. At least 4 equally spaced cell rates between 0 Mbps to the maximum cell rate (found in test case SET-UP_UD) shall be used, for at least 10 minutes at each rate.
3. Testers A and B monitor the received cell streams.
4. Note any alarms that may be raised by both SUTs.
5. Repeat this test with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
Each SUT shall be able to transfer a cell stream to the other SUT at the cell rates chosen without any corruption, cell loss and missequencing.
No alarms shall be raised.

**36. Test Case ID: ATM/LT/2**

Test Case Name: Unidirectional traffic test for VCC.
Test Purpose: To verify the ability to transfer a cell stream in one direction at different cell rates.
Pre-requisite: Run if both SUTs implement VCC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least one unidirectional VCC between Testers A and B.
2. Test case SET-UP_UD.

Test Procedure:
1. Tester A generates a cell stream for each VCC.
2. At least 4 equally spaced cell rates between 0 Mbps to the maximum cell rate (found in test case SET-UP_UD) shall be used, for at least 10 minutes at each rate.
3. Testers A and B monitor the received cell streams.
4. Note any alarms that may be raised by both SUTs.
5. Repeat this test with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
Each SUT shall be able to transfer a cell stream to the other SUT at the cell rates chosen without any corruption, cell loss and missequencing.
No alarms shall be raised.

**37. Test Case ID: ATM/LT/3**

Test Case Name: Simultaneous bidirectional traffic test on VPC.
Test Purpose: To verify the ability to transfer cell streams in both directions simultaneously at different cell rates.
Pre-requisite: Run if both SUTs implement VPC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least one bidirectional VPC between Testers A and B.
2. Test case SET-UP_BD.

Test Procedure:
1. Testers A and B generate independent cell streams for each direction and for each VPC.
2. At least 4 equally spaced cell rates between 0 Mbps to the maximum cell rate (found in test case SET-UP_BD) shall be used, for at least 10 minutes at each rate.
3. Testers A and B monitor the received cell streams.
4. Note also any alarms that may be raised by both SUTs.

Verdict Criteria:
The two SUTs shall be able to transfer bidirectional cell streams simultaneously at the cell rates chosen without any corruption, cell loss, and missequencing.
No alarms shall be raised.

**38. Test Case ID: ATM/LT/4**

Test Case Name: Simultaneous bidirectional traffic test on VCC.
Test Purpose: To verify the ability to transfer cell streams in both directions simultaneously at different cell rates.
Pre-requisite: Run if both SUTs implement VCC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least one bidirectional VCC between Testers A and B.
2. Test case SET-UP_BD.

Test Procedure:
1. Testers A and B generate independent cell streams for each direction and for each VCC.
2. At least 4 equally spaced cell rates between 0 Mbps to the maximum cell rate (found in test case SET-UP_BD) shall be used, for at least 10 minutes at each rate.
3. Testers A and B monitor the received cell streams.
4. Note also any alarms that may be raised by both SUTs.

Verdict Criteria:
The two SUTs shall be able to transfer bidirectional cell streams simultaneously at the cell rates chosen without any corruption, cell loss, and missequencing.
No alarms shall be raised.

**39. Test Case ID: ATM/LT/5**

Test Case Name: Handling of multiple VPCs.
Test Purpose: To determine the ability of the two SUTs to transfer cell streams with multiple virtual connections.
Pre-Requisite: Run if both SUTs implement VPC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least 10 unidirectional VPCs between Testers A and B.
2. Test case SET-UP_UD.

Test Procedure:
1. Tester A generates cell streams for each VPC.
2. The combined cell rate of all of VPCs shall not exceed the maximum cell rate (found in test case SET-UP_UD).
3. Test shall be conducted for at least 10 minutes.
4. Note also any alarms that may be raised by both SUTs.
5. Test shall be repeated with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
No cells shall be lost, corrupted, or missequenced.
No alarms shall be raised.

**40. Test Case ID: ATM/LT/6**

Test Case Name: Handling of multiple VCCs.
Test Purpose: To determine the ability of the two SUTs to transfer cell streams with multiple virtual connections.
Pre-Requisite: Run if both SUTs implement VCC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least 10 unidirectional VCCs between Testers A and B.
2. Test case SET-UP_UD.

Test Procedure:
1. Tester A generates cell streams for each VCC.
2. The combined cell rate of all of VCCs shall not exceed the maximum cell rate (found in test case SET-UP_UD).
3. Test shall be conducted for at least 10 minutes.
4. Note also any alarms that may be raised by both SUTs.
5. Test shall be repeated with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
No cells shall be lost, corrupted, or missequenced.
No alarms shall be raised.

**41. Test Case ID: ATM/LT/7**

Test Case Name: Payload pattern test on VPCs.
Test Purpose: To determine the ability of the two SUTs to transfer the payload of a cell stream transparently.
Pre-Requisite: Run if both SUTs implement VPC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least one unidirectional VPC between Testers A and B.
2. Test case SET-UP_UD.
3. Configure the Tester A to generate a cell stream of 90% of the maximum cell rate (found in test case SET-UP_UD).

Test Procedure:
1. Tester A generates a cell stream for each VPC with different specified payload patterns.
2. At least 2 patterns should be tested: an alternating series of 101010101... (binary) and an incrementing pattern of 01 02 03 04 ... (hexadecimal).
3. Note also any alarms that may be raised by both SUTs.
4. Test should be repeated with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
The two SUTs should be able to transfer the payload of the cell stream transparently without any cell loss or corruption.
No alarms shall be raised.

**42. Test Case ID: ATM/LT/8**

Test Case Name: Payload pattern test on VCCs.
Test Purpose: To determine the ability of the two SUTs to transfer the payload of a cell stream transparently.
Pre-Requisite: Run if both SUTs implement VCC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least one bidirectional VCC between Testers A and B.
2. Test case SET-UP_UD.
3. Configure the Tester A to generate a cell stream of 90% of the maximum cell rate (found in test case SET-UP_UD).

Test Procedure:
1. Tester A generates a cell stream for each VCC with different specified payload patterns.
2. At least 2 patterns should be tested: an alternating series of 101010101... (binary) and an incrementing pattern of 01 02 03 04 ... (hexadecimal).
3. Note also any alarms that may be raised by both SUTs.
4. Test should be repeated with the relative positions of SUTs A and B interchanged.

Verdict Criteria:
The two SUTs should be able to transfer the payload of the cell stream transparently without any cell loss or corruption.
No alarms shall be raised.

**43. Test Case ID: ATM/LT/9**

Test Case Name: Endurance test on VPCs.
Test Purpose: To determine if the traffic on VPCs is degraded over time.
Pre-Requisite: Run if both SUTs implement VPC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least 10 bidirectional VPCs between Testers A and B.
2. Test case SET-UP_BD.
3. Configure the Testers A and B to generate cell streams at 90% of the maximum cell rate (found in test case SET-UP_BD).

Test Procedure:
1. Leave the configuration to run for at least 12 hours.
2. Testers A and B monitor the received cell streams.
3. Note also any alarms that may be raised by both SUTs.

Verdict Criteria:
No cells shall be lost, corrupted or missequenced during the entire duration of the test
No alarms shall be raised.

**44. Test Case ID: ATM/LT/10**

Test Case Name: Endurance test on VCCs.
Test Purpose: To determine if the traffic on VCCs is degraded over time.
Pre-Requisite: Run if both SUTs implement VCC.
Reference: None
Test Configuration: #1

Test Set-up:
1. Establish at least 10 bidirectional VCCs between Testers A and B.
2. Test case SET-UP_BD.
3. Configure the Testers A and B to generate cell streams at 90% of the maximum cell rate (found in test case SET-UP_BD).

Test Procedure:
1. Leave the configuration to run for at least 12 hours.
2. Testers A and B monitor the received cell streams.
3. Note also any alarms that may be raised by both SUTs.

Verdict Criteria:
No cells shall be lost, corrupted or missequenced during the entire duration of the test
No alarms shall be raised.