Verizon Technology Organization

Technical Memorandum

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Technology Test Suite for Verizon Signaling System 7 Network
MTP Level 2 and 3
Congestion

Version 1.1
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Revision History

Version	Contact	Action	
Version 1.0 10/17/2005	John W. Murphy	New	Draft document
Version1.1 10/28/05	John W. Murphy	Add	Expand document to include Supervisor comments
Actions Taken are: **New** = new document, **Add/Delete/Change** = a section or topic has been added, or deleted, or changed.			

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Definitions; MTP Level two Timers

Timer T1, Aligned and ready timer value set by the System Under Test (SUT) after proving period. The SUT sends a FISU then waits for an aligned indication (FISU) from the far end, tested as part of case 3.

Timer T2, Non-alignment timer, set after initial link alignment is started. The SUT begins the alignment process, changes link status from Out of Service to stage one alignment. This timer is tested in case 1.

Timer T3, Aligning timer is set when the SUT moves from the Out-of-Alignment (stage 1) to stage 2, aligning/proving. Regardless of alignment declaration, the T3 waits for a similar response from the far end. This timer is tested in case 2.

Timer T4, The proving period timer, the type of proving declared will dictate the timer value used. The normal T4 (T4n) timer is tested in case 3, the emergency value (T4e) is tested in case 9.

Timers T5 (sending Status Indication Busy) and T6 (level 2 remote congestion) are set when the far end declares level two congestion. The T5 is activated when the SUT receives an SIB message. The T5 overrides the T7 (excessive delay) and keeps the link aligned/active during a part of the flow control declaration. Timer T6 is activated to measure the length of the flow control declaration. If the period of flow control exceeds T6, the SUT will remove the link from service. Both are tested as part of case 24.

Timer 7, excessive delay of acknowledgement is set pending a far end acknowledgement of a transmitted MSU. This timer function is tested in case 23.

Timer T15 and T16 are set by the SUT after receipt of a Transfer Control (TFC), Network Congestion Message. Timer T15 controls the interval between receipt of a TFC to sending a Route Set Congestion Test Message (RCT). Once timer T15 expires and the RCT are sent, the SUT sets T16 (wait for route set congestion status). If no further TFC messages are received, the SUT sends a RCT with a lower congestion priority and resumes ISUP traffic base on message priority. Both timers are tested in case 32.

Timer T20 is set when the near end is requested to inhibit a link. Tested in case 29, at the expiration of this timer the SUT is expected to generate a Link Remote Inhibit Test Message (LRI) reset the timer and continue sending LRI messages at a T20 interval.

1.0 Executive Overview

This Paper details the test steps used to evaluate the Message Transfer and Congestion part of the Signaling System 7 protocol. Tests outlined in this paper are posted in the ANSI, Telcordia, and NIIF documentation. References given are found in Telcordia's Generic Requirement (GR-905-CORE).

2.0 Technical Scope

This paper covers the levels two and three of the MTP protocol. Testing covers links in a non-aligned and aligned state. Test cases are designed to evaluate Timer values, aligned/non-aligned error rate monitors, and reaction to unexpected/incorrect events. The last three cases deal with the protocol response to congestion; these cases do not verify the SUT with respect to shedding ISUP traffic. All timer values are listed in Table B1 of GR-905-CORE. Timer values listed in the Provisional column are preferred, if not listed for the particular timer the default sequence is; recommended value then recommended range.

MTP level two and three tests are supported by a number of test set vendor devices. Some of the devices used are (but not limited to) the Network Services Test System™[1] (NSTS), Message Generation Test System™[2] (MGTS), and Spectra NT™[3]. All three units support MTP level testing. The various vendors may or may not supply MTP test programs but all three do support "locally developed" test scripts. Both MGTS and NSTS use a UNIX™[4] based control platform while the Spectra is a Windows™[5] based system.

[1] Network Services Test System is a Telcordia product.

[2] Message Generation Test System is a Catapult product

[3] The Spectra NT is made by Tektronix

[4] UNIX is a SUN software product.

[5] Windows is a trademarked product of Microsoft.

3.0 Technical Description

In this section, the TM will outline a typical test configuration and test cases for each requirement.

MTP Level 2/3 and Congestion Test Configuration

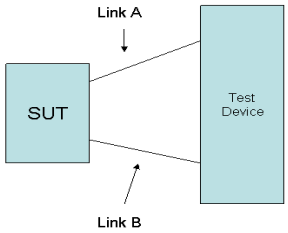

Figure 1: Typical MTP Test Configuration

Test Configuration Requirements:

1. A minimum of two 56 kb/s signaling links.
2. An intrusive type of test device capable of controlling alignment/pre-aligned link states.
3. A test device program capable of generating the proper test sequences to verify levels two and three of the signaling protocol.
4. A test device program capable of generating the test sequences for verification of Network congestion.

Test Case # 1: MTP level 2, Timer T2 value

Objective: The terminal being tested should attempt to align the link and should send SIO - Status Indicator Out-of-Alignment (State 01). Timer T2 is started upon entry into State 01. The value set for Timer T2 should comply with the value given in GR-905-CORE, Table B1. This value is stated as 11.5 seconds however, the Network Interconnection/Interoperability Forum suggests a T2 value of 23 seconds be used for all elements subtending an Signal Transfer Point (STP). This test case is supported in GR-905-CORE and the NIIF as case 1.1.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	--->	← Measure from here
T2 timer expires 11.5 or 23 seconds		
SIOS	--->	← to here

Test Setup:

1. Have the System Under Test (SUT) begin link alignment.
2. The test program holds alignment at SIOS (out of service) state.
3. Verify the SUT T2 timer value once it returns the alignment state to Out of Service.

Test Case # 2: MTP level 2, Timer T3 value

Objective: The terminal being tested should attempt to align the link and send SIO. The test unit responds with SIO. The terminal sends SIN or SIE (Normal or Emergency proving). The test unit continues to send SIO. The value set for Timer T3 should comply with the value given in GR-905-CORE, Table B1. This value is stated as 11.5 seconds. This test case is supported in GR-905-CORE and the NIIF as case 1.2.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIE/SIN	--->	← Measure from here
T3 timer expires 11.5 seconds		
SIOS	--->	← to here

Test Setup:

1. Have the SUT begin alignment.
2. The test program sends an SIO and holds alignment at that point.
3. The SUT should respond by sending either an SIN (normal) or SIE (emergency) alignment request.
4. The test program will not respond causing the SUT to stop alignment, send an SIOS after timer T3 expires.

Test Case # 3: MTP level 2, Timers T1 and T4 (normal)

Objective: To test the SUT's Normal Alignment Timer T4n. The terminal being tested will attempt to align the link under Normal Alignment conditions by sending an SIO. The test unit responds with an SIO. The test unit holds alignment at SIN while the SUT attempts to align the link. Timer T4n should be set for 2.3 seconds and Timer T1 should expire after 13 seconds. This test case is supported in GR-905-CORE and the NIIF as case 1.3. NOTE: Newer Elements will align the first link to another element (i.e., SSP to STP) in Emergency regardless of status of other link. Normal proving cannot be evaluated unless more than 50% of all links are aligned (two links out of three in a link set). This condition will affect all following tests specifically designed for Normal alignment functions.

SUT		**LEC**		
SIOS	<-->	SIOS		
SIO	<-->	SIO		
SIN	--->			
	<---	SIN	←	Measure from here
T4 (N) timer 2.3 seconds				
FISU	--->			to here for T4n
T1 timer expires in 13 seconds				
SIOS	--->	←		to here for T1

Test Setup:

1. Have the SUT attempt alignment.
2. The test script responds by sending an SIO
3. The SUT should send an SIN.
4. The test script sends and holds alignment at SIN.
5. After timer T4n, the SUT sends a FISU and sets timer T1.
6. The test script holds at SIN, the SUT's T1 expires.
7. Upon timer T1 expiring, the SUT removes the link from service by sending an SIOS.

Test Case # 4: Deactivation During Alignment

Objective: To test the response to the receipt of an SIOS during initial alignment (send SIOS Immediately after SUT sends SIN/E). Initiate link alignment. After receiving either and SIN or SIE from the terminal being tested, the test unit sends SIOS. This test case is supported in GR-905-CORE and the NIIF as case 1.6.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIN/E	--->	
	<---	SIOS
SIOS	--->	

Test Setup:

1. Have the SUT begin alignment by sending an SIO
2. The test script responds by sending an SIO.
3. The SUT then sends an SIN or SIE.
4. The test script reacts based on the SIN/E messages by sending an SIOS within the declared alignment timer.

Test Case # 5: Alignment Error Rate Monitor (Below Threshold), Normal Alignment.

Objective: To test the AERM at a below-threshold rate. Initiate normal alignment. During the T4 proving period the test unit will send good FISUs with four corrupt FISUs inserted every 2 seconds. This pattern repeats until a total of 16 corrupt FISUs have been sent (proving period restarts on the fifth cycle). This test case is supported in GR-905-CORE and the NIIF as case 1.16.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIN	--->	
	T4 (N) Timer	
	<---	send 4 cycles
		BAD
		BAD
		BAD
		BAD
		SIN
		FISU
	<---	one cycle
	<---	SIN
	<---	FISU
FISU	--->	

Test Setup:

1. Have the SUT start link alignment.
2. The test script responds by sending four cycles of BAD FISUs followed by an SIN and good FISU.
3. On the fifth cycle the test script sends an SIN and good FISU.
4. The SUT responds by sending an FISU indicating alignment.
5. The test script will not respond and the SUT removes the link from service (sends SIOS).

Test Case #6 Alignment Error Rate Monitor, Above Threshold, Normal Alignment

Objective: To test the AERM at an above-threshold rate, link should be removed from service. Initiate the normal link alignment procedure. During the T4 proving period the test unit will send good FISUs with four corrupt FISUs inserted every 2 seconds. This test case is supported in GR-905-CORE and the NIIF as case 1.17.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIN	--->	
	T4 (N) Timer	
	<---	send 5 cycles
		BAD
		BAD
		BAD
		BAD
		SIN
		FISU
SIOS	--->	

Test Setup

1. Have the SUT begin alignment.
2. The test script sends five corrupted alignment cycles
3. At the end of the fifth bad cycle the SUT sends an SIOS

Test Case #7 Alignment Error Rate Monitor (Above Threshold) Emergency Alignment

Objective: Same as above, however, the link is in emergency proving.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIN	--->	
	T4 (E) Timer	
	<---	send 1 cycle
		BAD
		BAD
		BAD
		BAD
		SIE
		FISU
SIOS	--->	

Test Setup:

1. Have the SUT start alignment.
2. The SUT declares Emergency proving.
3. The test script sends one failed proving cycle.
4. The SUT removes the link from service by sending an SIOS.

Test Case #8 Deactivation during the Proving Period

Objective: To test the response to the receipt of SIOS during the proving period. With the link out of service, have the terminal start alignment. After the terminal and the test unit begin sending SIN/SIE, but before they begin sending FISUs, the test unit will send an SIOS. This test case is supported in GR-905-CORE and the NIIF as case 1.9.

SUT		**LEC**
SIOS	<-->	SIOS
SIO	<-->	SIO
SIN	--->	
	<T4 (N) Timer	
	<---	SIOS
SIOS	--->	

Test Setup:

1. Have the SUT begin alignment.
2. The test script sends an SIO, the SUT reacts by sending an SIN.
3. Prior to the SUT's T4n timer, the test script sends an SIOS.
4. The SUT removes the link from service.

Test Case #9 Timer T4 Emergency Alignment

Objective: To test the terminal being tested for correct operation of Timer T4e. Initiate alignment ensuring emergency proving period. The link should align in approximately 600 milliseconds. This test case is supported in GR-905-CORE and the NIIF as case 1.4.

SUT		**LEC**	
SIOS	<-->	SISO	
SIO	<-->	SIO	
	T4E timer, 600 ms.		
SIE	<-->	SIE	← **Measure from here**
FISU	--->		← **to here**

Test Setup:

1. Remove all links from service to force the SUT into emergency alignment.
2. Have the SUT begin alignment, the SUT should send SIE.
3. The test script responds by sending an SIE.
4. The SUT sends a FISU 600 ms. after receipt of an SIE.
5. The test script holds at SIE level and the SUT removes the link.

Test Case #10 SIO received on an in-Service Link

Objective: To check that the link is taken out of service if an SIO is received while the link is in the in-service state. Initiate link alignment and allow link to align normally. After the link enters the in-service state, the test unit sends an SIO. This test case is supported in GR-905-CORE and the NIIF as case 1.7.

SUT		**LEC**
	<---	SIO
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends an SIO on an aligned link.
2. The SUT should react by taking the link out of service (sends an SIOS).
3. The SUT should realign the link.

Test Case #11 SIOS Received on an in service Link

Objective: To test that the link is removed from service if an SIOS is received while the link is in the in-service state. Initiate link alignment and allow the link to align normally. After the link enters the in-service state, the test unit will send an SIOS. This test case is supported in GR-905-CORE and the NIIF as case 1.8.

SUT		**LEC**
	<---	SIOS
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends an SIOS on an aligned link.
2. The SUT should react by taking the link out of service (sends an SIOS).
3. The SUT should realign the link.

Test Case #12 Break Transmission Path – Link Aligned

Objective: This test attempts to simulate a break of the transmission path by sending steady aborts. This tests the terminal's ability to remove the link from service if the Signal Unit Error Rate Monitor (SUERM) exceeds the set limits. With the link aligned and ready, the test unit sends continuous aborts to the terminal being tested. This test case is supported in GR-905-CORE and the NIIF as case 1.10.

SUT		**LEC**
	<---	ABORT (steady)
SUREM exceeds limits		
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends steady ABORTS toward the SUT.
2. The SUT SUERM exceeds its limits.
3. The SUT sends an SIOS removing the link from service.

Test Case #13 Corrupt Fibs

Objective: To check the response to receipt of two corrupt Forward Indicator Bits (FIBs). The test starts with the link aligned and in service. The test unit will send two FISUs, both having inverted FIBs. This test case is supported in GR-905-CORE and the NIIF as case 1.11.

SUT		**LEC**
	<---	FISU (inverted FIB)
	<---	**1 copy**
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends two FISUs with inverted FIBs.
2. The SUT should remove the link from service by sending an SIOS.

Test Case #14 Flag Insertion within Octet Boundaries

Objective: To test the signal unit delimitation by sending a Message Signal Unit (MSU) with a flag inserted within its boundaries. With the link aligned and in service, the test unit will send an MSU with octet HEX 7F inserted within the message boundaries. This appears as a flag t the terminal receiver. The FSN of succeeding signal units sent by the test unit are incremented normally. This test case is supported in GR-905-CORE and the NIIF as case 1.12.

SUT		**LEC**
	<---	BAD
	<---	BAD
FISU (nak)	--->	

Test Setup:

1. The test script sends an MSU with an 7F inserted toward the SUT.
2. The SUT responds by sending a FISU indicating a negative acknowledgement (NAK).

Test Case #15 SUERM below Threshold

Objective: To test that the SUERM dose not remove the link form service with errors below the threshold (1 error in 256). With the link aligned and in service, the test unit sends good FISUs with a single corrupt FISU (with invalid CRC) every 300 milliseconds. Continue to send a single corrupt FISU every 300 ms. for several minutes. This test case is supported in GR-905-CORE and the NIIF as case 1.13.

SUT		**LEC**
	<---	FISU (bad)
	<---	FISUs (good)
	300 ms.	
	<---	FISU (bad)
	<---	FISU (good)
SUERM limit not exceeded		
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends a FISU with an invalid CRC every 300 ms followed by good FISUs.
2. The SUT's SUERM is expected to hold the link in service (error rate within limits).

Test Case #16 SUERM above Threshold

Objective: To test that the SUERM removes the link form service when errors exceed the threshold. With the link aligned and in service, the test unit sends a corrupt FISU (with invalid CRC) every 200 milliseconds. Continue to send a single corrupt FISU every 200 ms. for several minutes. This test case is supported in GR-905-CORE and the NIIF as case 1.14.

SUT		**LEC**
	<---	FISU (bad)
	<---	FISUs (good)
	200 ms.	
	<---	FISU (bad)
	<---	FISU (good)
	SUERM exceeds limits	
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends a FISU (with invalid CRC) every 200 ms.
2. The SUT SUERM exceeds its limits and removes the link from service (sends an SIOS).

Test Case #17 Consecutive Corrupt Signal Units

Objective: To test the SUERM when 64 consecutive signal units failing CRC checks are received. With the link aligned and in service, the test unit sends consecutive FISUs with incorrect CRC. This test case is supported in GR-905-CORE and the NIIF as case 1.15.

SUT		**LEC**
	<---	FISUs (bad)
SUERM exceeds limits		
SIOS	--->	

NOTE: Link will restore

Test Setup:

1. The test script sends steady FISUs with invalid CRC toward the SUT.
2. The SUT's SUERM exceeds its limits and removes the link from service (sends an SIOS).

Test Case #18 Negative Acknowledgment

Objective: To test the response to a negatively acknowledged MSU. With the link in service, the test unit sends an MSU requiring a response (e.g., SLTM) to the terminal being tested. After receiving a response, the test unit sends a FISU with an inverted BIB and BSN one less than the last received FSN (request for retransmission). This test case is supported in GR-905-CORE and the NIIF as case 1.18.

SUT		**LEC**
	<---	SLTM (N)
SLTA N)	--->	
	<---	FISU (nak)
SLTA (N)	--->	

Test Setup:

1. The test script sends an SLTM toward the SUT.
2. The SUT responds by sending an SLTA.
3. The test script sends a FISU (nak) to the SUT.
4. The SUT responds by re-transmitting the SLTA reflecting the nak'ed sequence number and indicator bit inversion.

Test Case #19 Erroneous Forward Indicator Bit (FIB)

Objective: To ensure correct performance when an erroneous FIB is received. With the link aligned and in service, the test unit sends an MSU with an erroneous FIB (indicates retransmission). This test case is supported in GR-905-CORE and the NIIF as case 1.20.

SUT		**LEC**
	<---	FISU (inverted FIB)
	<---	SLTM
FISU (nak)	--->	
No response to SLTM		
	<---	SLTM
SLTA	--->	

Test Setup:

1. The test script sends a FISU with an inverted FIB followed by a good SLTM.
2. The SUT sends a nak and discards the SLTM.
3. The test script sends a good SLTM.
4. The SUT responds by sending an SLTM.

Test Case #20 Erroneous Retransmission – Multiple FISU

Objective: To test the reception control response to the retransmission of multiple FISUs with inverted FIBs. With the link in service, the test unit sends FISUs with inverted FIB every other SU. This test case is supported in GR-905-CORE and the NIIF as case 1.21.

SUT		**LEC**
	<---	FISU (inverted FIB)
	<---	FISU (FIB good)
	<---	FISU (inverted FIB)
	<---	FISU (FIB good)
SIOS	--->	

NOTE: Link will realign.

Test Setup:

1. The test script sends FISUs with every other FIB inverted.
2. The SUT removes the link from service by sending an SIOS.

Test Case #21 Abnormal Backward Sequence Number (BSN), single MSU

Objective: To test the response to reception of an MSU with out-of-sequence BSN. With the link aligned, the test unit sends a single MSU requiring a response (e.g., SLTM) with an invalid BSN (acknowledging an MSU that has already been removed from the switch's retransmission buffer.). This test case is supported in GR-905-CORE and the NIIF as case 1.22.

SUT		**LEC**
	<---	SLTM (invalid BSN)

No response

Test Setup:

1. The test script sends an SLTM with an invalid BSN.
2. The SUT is expected to discard/not react to the MSU.

Test Case #22 Abnormal Backward Sequence Number

Objective: To test the response to reception of two FISUs with corrupt BSNs. The test unit sends two FISUs with invalid BSNs (acknowledging MSUs that have already been removed form the switch's retransmission buffer). This test case is supported in GR-905-CORE and the NIIF as case 1.23.

SUT		LEC
	<---	FISU (invalid BSN)
	<---	FISU (invalid BSN)
SIOS	--->	

NOTE: Link will realign.

Test Setup:

1. The test script sends two FISUs with invalid BSNs.
2. The SUT removes the link from service by sending an SIOS.

Test Case #23 Delay of Acknowledgment

Objective: To test the terminal's T7 Timer (delay of acknowledgment). With the link in service, the test unit sends an MSU that requires a response (e.g., SLTM). The test unit will not acknowledge receipt of received responses (by incrementing it's BSN). Timer T7 is supported by GR-905-CORE, Table B1 and should be set for one half second (0.5). This test case is supported in GR-905-CORE and the NIIF as case 1.24.

SUT		LEC
	<---	SLTM
SLTA	--->	← Measure from here

No response

T7 expires in .5 seconds

SIOS	--->	← to here

NOTE: Link will realign.

Test Setup:

1. The test script sends an SLTM toward the SUT.
2. The SUT responds by sending an SLTA and sets it's Timer T7,
3. No acknowledgement sent by the test script to the SLTA.
4. The SUT's T7 expires and the link is removed via an SIOS.

Test Case #24 Level 2 Flow Control

Objective: To evaluate the SUT's response to remote Level 2 flow control indication and the operation of its T6 Timer. Timers T5 and T6 are supported by GR-905-CORE, Table B1. Timer T5 should be set for 100ms and T6 set to 3 seconds. This test case is supported in GR-905-CORE and the NIIF as case 8.14.

SUT		**LEC**
	<---	SLTM (case 1)
SLTA	--->	
	<---	SIB
SLTM (#1)	--->	
	<---	SIB
SLTM (#2)	--->	
T5 Timer interval		
	<---	SIB
SLTM (#N)	--->	
< SUT T6 Timer		
	<---	FISU (inverted BIB)
SLTM (#N)	--->	

	<---	SLTM (case 2)
SLTA	--->	
	<---	SIB
SLTM (#1)	--->	
	<---	SIB
SLTM (#2)	--->	
T5 Timer interval		
	<---	SIB
SLTM (#N)	--->	
> SUT T6 Timer		
SIOS	--->	

Test Setup:

1. Pre test, if possible have the SUT increase the number of SLTMs sent.
2. Pre test obtain the SUT T5 timer value and adjust the test script.
3. For case 1, the test script sends an SLTM, the SUT responds.
4. As the SUT sends SLTMs, the test script sends SIB messages within the T5 interval suppressing the SUT's T7 timeout.
5. Prior to expiration of the SUT's T6 timer, the script sends a FISU with an inverted BIB.
6. In case 2, the test script sends SIBs within the SUT's T5 interval and continues to send until the T6 expires.
7. After the SUT's T6 expires, an SIOS is sent to remove the link from service.

Test Case #25 Discrimination of Invalid Point Code

Objective: To test the ability to discard and/or respond to MSUs with invalid Originating Point Code (OPC), Destination Point Code (DPC), Signaling Link Code (SLC). The test unit sends several MSUs with invalid OPCs, DPCs, and invalid SLCs along with valid MSUs. This test case is supported in GR-905-CORE and the NIIF as case 1.26.

SUT		**LEC**
	<---	SLTM (good)
SLTA	--->	
	<---	SLTM (various problems)
No response		

Test Setup:

1. The test script sends a valid SLTM toward the SUT
2. The SUT responds by sending an SLTA.
3. The test script then sends SLTMs with an invalid DPC, OPC, and SLC
4. The SUT should not respond to any SLTM sent with invalid information.

Test Case #26 Change-over/Change-back

Objective: To changeover to the alternate link (or link within a link set) when a link (or link within a link set) becomes unavailable. The test is run without background traffic. During other testing it may be possible to observe COO/CBD messages and determine if the SUT is conducting this function correctly. Note the last sequence number received (by the SUT) prior to the link failure, open the COO and make sure the number contained in the MSU is correct. This test combines the 1.30 and 1.32 test function into one test case. This test case is supported in GR-905-CORE and the NIIF as cases 1.30 and 1.32.

SUT		**LEC**
	<---	SLTM (1)
SLTA	--->	
	<---	SLTM (N)
SLTA	--->	
	<---	SIOS (link A)
COO (link B)	--->	
	<---	SIO/SIN (link B realigns)
CBD (link B)	--->	

Test Setup:

1. If needed, send a number of SLTMs to increment the sequence number.
2. Note the last sequence number prior to failing the link.
3. Fail one link toward the SUT.
4. The SUT is expected to send a COO message containing the last (noted) sequence number within the message.
5. Restore the failed link, the SUT should send a CBD.

Test Case #27 Link Inhibit, Link Inhibit Denial

Objective: To test the SUT's response to a Link Inhibit (LIN) message sent with incorrect parameters and that the SUT will not allow the last signaling link within a link set (or multilink set) be inhibited. With all links aligned, send a LIN message to the SUT. Send another LIN on the other link. This test case is supported in GR-905-CORE and the NIIF as cases 1.33 and 1.35.

SUT		LEC
	<---	LIN (test 1)
No response		
	<---	LIN (test 2 & 3)
TFP	--->	
	<---	LIN (test 4 & 5)
no response		
	<---	LIN (link A)
LIA (link A)	--->	
	<---	LUN (link A)
LUA (link A)	--->	
	<---	LIN (link A)
LIA (on link A)	--->	
		Change to the other link
	<---	LIN (link B)
LID (link B)	--->	
	<---	LUN (links A)
LUA (link A)	--->	

Test Setup:

1. The test script sends a number of LIN messages containing invalid information (DPC/OPC with invalid octets, and an invalid SLC) and incorrectly coded H0 and H1 bits.
2. The SUT should not react to any invalid coded message (might send a TFP on messages containing the invalid DPC).
3. During part two the test script sends a valid LIN toward the SUT.
4. The SUT returns a LIA message indicating the link in inhibited.
5. The test script now sends a LIN message on the last available link.
6. The SUT is expected to send a LID message, keeping the link in service.

Test Case #28 Link Forced Uninhibited - Processor Outage/Failure

Objective: To test the SUT's ability to force a link into service. With all links in service, the test unit will send an LIN on one link. Then the unit will send a Status Indicator, Processor Outage (SIPO) message on the inhibited link. The second phase of this test takes the uninhibited link out of service. The SUT is expected to force the inhibited link back into service. This test case is supported in GR-905-CORE and the NIIF as cases 1.36.

SUT		LEC
Change to the other link		LIN (link B)
LIA		
	<---	LIN (link A)
LID (on link A)	--->	
	<---	SIPO (link A)
LFU (on link B)	--->	
	<---	LUN (link B)
	<---	SIPO (link A continues)
FISU (only)	--->	
	<---	FISU (link A)
SLTM (link A)	--->	
	<---	SLTA (link A)
CBD (link B)	--->	
	<---	CBA (link B)

Test Setup:

1. For the first part, the test script sends a Link Inhibit message on link B.
2. The SUT responds by sending an acknowledgement.
3. The test script attempts to inhibit link A, the SUT sends a LID.
4. The test script then sends a processor outage (SIPO) message on link A.
5. The SUT forces link B back into service.
6. Once the SIPO messages stop, an exchange of SLTMs show the link back in service.
7. The SUT sends a CBD on link B.
8. Part two follows the same message exchange but the test script sends an SIOS instead of a SIPO
9. The SUT is expected to force the inhibited link back into service.

Test Case #29 Inhibiting Test, Timer T20

Objective: To test that the terminal performs the management inhibiting test correctly. Inhibit a link and observe that a Local Link Inhibit (LLI) and Link Remote Inhibit (LRI) messages are exchanged. This test case is supported in GR-905-CORE and the NIIF as cases 1.37.

SUT		**LEC**
	<---	LIN (link A)
LIA (on link A)	--->	
LRI (on link B)	--->	← measure from here
		No response
T20 expires (90 to 120 seconds)		
LRI (on link B)		← to here
	<---	LUN (link A)
LUA (link A)	--->	

Test Setup:

1. The test script sends a LIN.
2. The SUT responds by sending a LIA then sets Timer T20.
3. The test script will not respond and timer T20 expires.
4. The SUT sends a Link Remote Inhibit (LRI) message and resets T20.
5. The test script doses not respond.
6. The SUT T20 expires and it sends another LRI.
7. The test script sends a Link Uninhibited message.

Test Case #30 Response to Congestion Test

Objective: This test evaluates the SUT's ability to restrict traffic toward a congested location. In addition, the SUT should follow the RCT message sequence to resolve a congested condition.

SUT		**LEC**
	<---	TFC (L=3)
	<---	ANM (TCIC A)
RCT (p=2)	--->	
	<---	TFC (L=2)
RCT (p=1)	--->	
	<---	TFC (L=1)
RCT (p=0)	--->	
RSC (TCIC A)	--->	
	<---	RLC (TCIC A)

Test Setup:

1. The Script sends a TFC (congestion level =3) and an ANM toward the SUT.
2. The SUT responds with a RCT (Priority =2) message.
3. The Script sends another TFC (congestion level =2).
4. The SUT responds with a RCT (Priority =1) message.
5. The Script sends another TFC (congestion level =1).
6. The SUT responds with a RCT (Priority =0) message.
7. The SUT sends a RSC message in response to the ANM sent above.

Test Case #31 Response to Congestion Test

Objective: This test evaluates the SUT's T15 and T16 Timer for correct time values. It ensures that the SUT will correctly resolve a congested condition.

SUT		LEC
	<---	TFC (L=3)
	Within T15 Interval	
	<---	TFC (L=3)
	T15 allowed expiring	
RCT (P=2)	--->	
	<---	TFC (L=3)
RCT (P=2)	--->	
	<---	TFC (L=3)
RCT (P=2)	--->	
	No response	
	T16 expires	
RCT (P=1)	--->	
RCT (P=0)	--->	

Test Setup:

1. The Script sends a TFC message establishing a congestion level of three.
2. The Script continues to send TFCs to maintain the SUT's T15 Timer.
3. The Script allows the SUT's T15 Timer to expire.
4. The SUT sends a RCT message.
5. The Script responds to the RCT messages by sending TFCs.
6. The Script stops responding to the RCTs, allowing the SUT's T16 Timer to expire.
7. The SUT continues to send RCT messages lowering the level of congestion.

Test Case #32 Response to Congestion Test

Objective: This test case evaluates the SUT's ability to react to a congestion message received containing a known affected location but sent from a non-adjacent STP. The TFC message will be coded using a non-adjacent STP point code in the OPC file.

SUT	**LEC**	
	<---	TFC (L=3)
RCT	--->	

Test Setup:

1. The test script sends a TFC with an OPC of a non-adjacent STP containing a valid Affected Location.
2. The SUT responds by sending a Route set Test Message.

4.0 Acronyms

Acronym	Definition
AERM	Alignment Error Rate Monitor
AMN	Answer Message (ISUP)
ANSI	American National Standards Institute
BIB	Backward Indicator Bit
BSN	Backward Sequence Number
COO	Changeover Order
CBD	Chargeback Declaration
DPC	Destination Point Code
FIB	Forward Indicator Bit
FISU	Fill In Signaling Unit
GR	Generic Requirement
LIA	Link Inhibit Acknowledgement
LID	Link Inhibit Denial
LFU	Link Forced Inhibited
LIN	Link Inhibit
LRI	Link Remote Inhibit Test Message
MTP	Message Transfer Part
NAK	Negative Acknowledgement
NIIF	Network Interoperability Interconnection Forum
NOF	Network Operations Forum
OPC	Originating Point Code
RCT	Route set Congestion Test Message
RLC	Release complete (ISUP)
RSC	Reset Circuit (ISUP)
SIB	Status Indication Busy
SIE	Status Indication Emergency (alignment)
SIO	Status Indication Originating (alignment)
SIOS	Status Indication Out of Service
SIN	Status Indication Normal (alignment)

SIPO	Status Indication Processor Outage
SLC	Signaling Link Channel
SLTA	Signaling Link Test Message Acknowledgment
SLTM	Signaling Link Test Message
SUT	System Under Test
TFC	Transfer Congestion
TFP	Transfer Prohibit (ISUP)
SUERM	Signaling Unit Error Rate Monitor