Version 12-456v0 Changes

This document describes changes to the “Test Initialization” section in SB-5 draft T11/12-203v0 per letter ballot comment resolutions. Strikethroughs indicate deleted material and underlines indicate new material. Change bars indicate overall changes to the FC-SB-4 standard.

Version 13-034v0 Changes

This document describes additional changes to the “Test Initialization” section in SB-5 draft T11/12-203v0 per letter ballot comment resolutions. Strikethroughs indicate deleted material and double underlines indicate new material. Change bars indicate overall changes to the FC-SB-4 standard.

6.4.7 Test Initialization

6.4.7.1 Test Initialization Overview

The test-initialization (TIN) IU provides a method for determining which logical paths are considered established for a channel image or control-unit image, and for determining which logical paths are capable of being established for a channel image with a control unit.

When the TIN IU is used to determine the logical paths that are considered established for a channel image or control-unit image, the function performed by the TIN IU is defined as the TIN function; when the TIN IU is used to determine the logical paths that are capable of being established for a channel, the function performed by the TIN IU is defined as the TIN Capability (TINC) function. The TIN function is performed when the TIN IU contains a link header with bit 7 of byte zero of the link-control-information field set to zero. The TINC function is performed when the TIN IU contains a link header with bit 7 of byte zero of the link-control-information field set to one.

The TIN and TINC functions are described in the following sections.

6.4.7.2 Test Initialization Function

The test-initialization (TIN) function shall provide a method for determining which logical paths are considered established for a channel image or control-unit image. The TIN function shall be performed by sending a TIN IU that specifies the TIN function and is specified in either basic or extended mode. Basic or extended mode shall be specified by the value of the image-ID count field contained in byte one of the link-control information field. If the value of the count field is zero, a basic-mode TIN function is specified. If the value is non-zero, an extended-mode TIN function is specified. The link-control DIB shall contain a link header with a link-control field specifying hex '09' with bit 7 of byte zero of the link-control-information field set to zero. No link payload is provided for the TIN function. A TIN IU that specifies the TIN function is referred to as the TIN function and a TIR IU that specifies the TIR function is referred to as the TIR function.

It shall be model dependent as to whether the channel or control unit uses basic or extended mode; however, if basic mode is used, the receiver shall correspondingly use basic mode for the TIR function in response; otherwise a link-level protocol error shall be recognized. Unless stated otherwise, text pertaining equally to both basic and extended modes will not be referenced by either mode. Whenever text pertains to a particular mode of operation, the appropriate mode will be specified.

A channel or control unit may send the TIN function at any time; however, when initiative to perform the test-initialization function is generated, the TIN function shall be sent. The occurrence of any of the following events at a channel or control unit shall create the initiative to send a TIN function as defined below:

a) If an RSCN is accepted by the N_Port of a channel or a control unit and one or more of the affected N_Ports is the N_Port of a channel or control unit to which one or more logical paths are indicated as be-

ing established, initiative to send a TIN function to each channel or control unit to which a logical path is indicated as being established shall be generated;

b) If the N_Port of a channel receives the LOGO ELS request from the N_Port of a control unit at a time when internal indicators at the channel indicate that one or more logical paths exist with the control unit, initiative to send a TIN function to the control unit shall be generated;

c) If the N_Port of a control unit receives a PLOGI ELS request from the N_Port of a channel at a time when one or more logical paths are indicated as being established to the channel, initiative to send a TIN function to the channel shall be generated; or

d) If a control unit exits the FC-FS-3 link failure state at a time when one or more logical paths are indicated as being established to one or more channels, initiative to send a TIN function to each channel to which a logical path is indicated as being established shall be generated.

Once initiative to send a TIN function to either a channel or control unit is generated, subsequent occurrences of any of the above events shall not create initiative to send another TIN function to the same channel or control unit if initiative to send the first TIN function has not been discharged. For a channel, initiative to send a TIN function to a control unit shall be discharged after the TIN function has been sent and a TIR function has been received in response or an event occurs which requires the removal of all logical paths to the control unit. For a control unit, initiative to send a TIN function to a channel shall be discharged if one of the following occurs:

a) A TIN function has been sent to the channel and a TIR function is received in response;

b) A logical path time-out condition for the channel has been recognized by any control-unit image, and the control unit has attempted to send a TIN function to that channel after recognizing the time-out condition, (See 10.2.4 for information on the recognition of a logical path time-out condition.); or

c) An event occurs which requires the removal of all existing logical paths to the channel.

Upon accepting a TIN function, the recipient shall check whether it has logical paths with the source of the TIN function. The normal response is a TIR function.

When a channel sends a TIN function in basic mode, the logical paths to be tested for establishment shall be specified by the channel N_Port ID and channel image ID. The control-unit image ID field shall be set to zero by the channel and ignored by the control unit.

When a control unit sends a TIN function in basic mode, the logical paths to be tested for establishment shall be specified by the control-unit N_Port ID and control-unit image ID. The channel image ID field shall be set to zero by the control unit and is ignored by the channel.

When the channel sends a TIN function in extended mode, the set of logical paths to be tested for establishment shall be specified by the channel N_Port ID, the channel image ID, and an 8-bit image-ID count value contained in byte one of the link-control information field. The range of logical paths to be tested shall be determined starting with the channel image ID and incrementing to the smaller of a) the extent specified by the 8-bit image-ID count value, or b) a maximum channel image ID of 255. The image-ID count field shall be interpreted as an 8-bit unsigned binary integer, and the value in the field may range from 1 to 255. The value in the image-ID count field indicates the number of channel images beyond 1 to be tested. (e.g., a channel image ID of 2 and a count of 3 will test the 4 channel images 2, 3, 4, and 5). If the value in the image-ID count field is greater than 253, it shall be regarded by the control unit as an image-ID count of 253. The control-unit image ID shall be set to zero by the channel and is ignored by the control unit.

When the control unit sends a TIN function in extended mode, the set of logical paths to be tested for establishment shall be specified by the control-unit N_Port ID, the control-unit image ID, and an 8-bit image-ID count val-

ue contained in byte one of the link-control information field. The range of logical paths to be tested for establishment shall be determined starting with the control-unit image ID and incrementing to the smaller of a) the extent specified by the 8-bit image-ID count value, or b) a maximum control-unit image ID of 255. The image-ID count field shall be interpreted as an 8-bit unsigned binary integer, and the value may range from 1 to 255. The value in the image-ID count field indicates the number of control-unit images beyond 1 to be tested. (e.g., a control-unit image ID of 2 and a count of 3 will test the 4 control-unit images 2, 3, 4, and 5). If the value in the image-ID count field is greater than 253, it shall be regarded by the channel as an image-ID count of 253. The channel image ID shall be set to zero by the control unit and ignored by the channel.

NOTE – The maximum upper limit of the contents of the image-ID count field is specified as 253 to allow the payload of the extended TIR function to be contained within a single IU. If additional images beyond the specified maximum of ~~253~~ 254 need to be verified, then additional basic-mode or extended-mode TIN IUs need to be sent that specify the TIN function.

6.4.7.3 Test Initialization Capability Function

The test-initialization capability (TINC) function provides a method for a channel to determine the logical paths that are capable of being established between a channel image and a control unit. The TINC function shall be performed by the channel sending a TIN IU that specifies the TINC function to a control unit. The link-control DIB shall contain a link header with the link-control field specifying hex '09' with bit 7 of byte zero of the link-control-information field set to one. No information is provided in the link payload for the TINC function. A TIN IU that specifies the TINC function is referred to as the TINC function and a TIR IU that specifies the TINCR function is referred to as the TINCR function.

A channel may send a TIN IU that specifies the TINC function at any time. Upon receiving a TIN IU that specifies the TINC function, the control unit determines the logical paths that it is capable of establishing with the channel images specified in the TIN IU and performs the TINCR function. The set of logical paths the control unit considers capable of being established includes all logical paths that are already established and logical paths that are permitted to be established according to the control-unit configuration. Depending on the resources available at the control unit, it may not be possible to establish all the indicated logical paths at a given time.

When the channel sends a TIN IU that specifies the TINC function, the set of logical paths to be tested for establishment capability shall be specified by the channel N_Port ID, the channel image ID, and an 8-bit image-ID count value contained in byte one of the link-control information field. The range of logical paths to be tested shall be determined starting with the channel image ID and incrementing to the smaller of a) the ~~extent~~ number of images specified by the 8-bit image-ID count value, or b) a maximum channel image ID of 255. The image-ID count field shall be interpreted as an 8-bit unsigned binary integer, and the value in the field may range from 0 to 255. The value in the image-ID count field indicates the number of channel images to be tested. (e.g., a channel image ID of 2 and a count of 3 will test the channel images 2, 3, and 4). This differs from the definition of the image-ID count field in the TIN function. If the value in the image-ID count field is greater than ~~253~~ 254, it shall be regarded by the control unit as an image-ID count of ~~253~~ 254. If the value of the image-ID count is zero, it shall be regarded by the control unit as an image-ID count of 1. The control-unit image ID shall be set to zero by the channel and is ignored by the control unit.

NOTE – The maximum upper limit of the contents of the image-ID count field is specified as ~~253~~ 254 to allow the payload of the TINCR function to be contained within a single IU. If additional images beyond the specified maximum of ~~253~~ 254 need to be verified, then additional TIN IUs that specify the TINC function need to be sent.

6.4.8 Test Initialization Result

6.4.8.1 Test Initialization Result Overview

The test-initialization-result (TIR) IU shall be used to confirm the successful completion of either the TIN function or the TINC function.

When the TIR IU is sent to confirm successful completion of the TIN function, the function performed by the TIR IU is defined as the TIR function. When the TIR IU is sent to confirm successful completion of the TINC function, the function performed by the TIR IU is defined as the TINCR function. The TIR function is indicated when the TIR IU contains a link header with bit 7 of byte zero of the link-control-information field set to zero. The TINCR function is indicated when the TIR IU contains a link header with bit 7 of byte zero of the link-control-information field set to one. A TIR IU shall be sent only as a response to a TIN IU that is accepted.

The TIR and TINCR functions are described in the following sections.

6.4.8.2 Test Initialization Result Function

The test-initialization-result (TIR) function shall confirm the successful completion of the TIN function and shall indicate which logical paths are considered established for the channel or control unit performing the TIR function. The TIR function shall be specified in either basic or extended mode as determined by the value of the image-ID count field contained in byte one of the link-control information field. If the value is zero, a basic-mode TIR function is specified. If the value is non-zero, an extended-mode TIR function is specified. The TIR IU for the TIR function shall contain a link header with a link-control field specifying hex '01' with bit 7 of byte zero of the link-control-information field set to zero.

The TIR function shall be performed by sending a TIR IU that specifies the TIR function. A basic-mode TIR function shall be sent in response to a basic-mode TIN function and may also be sent in response to an extended-mode TIN function. An extended-mode TIR function shall only be sent in response to an extended-mode TIN function; otherwise, a link-level protocol error shall be recognized.

When a TIR function is sent in basic mode, the link-control DIB shall contain a 32 byte logical path field in the link payload. (See Table 1 for the format of the logical path field.)

If a channel sends the basic-mode TIR function, the channel image ID field shall be set to zero by the channel and ignored by the control unit. The control-unit image ID field shall be the same as the control-unit image ID field received in the TIN function. If a control unit sends the basic-mode TIR function, the channel image ID field in the SB-4 header shall be the same as the channel image ID field received in the TIN function, and the control-unit image ID field shall be set to zero by the control unit and ignored by the channel.

The 32 byte link payload for the basic-mode TIR function has the format given in Table 1.

Table 1 – Logical Path Field - Basic

Word	Contents
0	Logical Paths 0 - 31
1	Logical Paths 32 - 63
2	Logical Paths 64 - 95
3	Logical Paths 96 - 127
4	Logical Paths 128 - 159
5	Logical Paths 160 - 191
6	Logical Paths 192 - 223
7	Logical Paths 224 - 255

The logical-path field shall indicate whether each of the 256 possible logical paths are considered established. There is a bit in the logical-path field for each possible logical path that may be established with the source of the TIN function. Each bit shall correspond to an image ID. Starting with bit 0, word 0, logical addresses 0 through 255 are assigned in ascending order. The bit for a logical address corresponding to a logical path shall be set to one if that logical path is established and shall be set to zero otherwise. (See 3.4.3 for a definition of the SB-4 bit numbering convention used in Table 1.)

When the basic-mode TIR function is received in response to a TIN function and one or more logical paths are indicated as not established when they were previously considered to be established, a test-initialization-result error shall be recognized. If one or more logical paths are indicated as being established when they were previously considered not established, a test-initialization-result error shall be recognized. For recovery from a test initialization result error, see 11.2.9. If a test-initialization-result error is not recognized, no action shall be taken.

When an extended-mode TIR function is sent, the link-control DIB shall contain a link header with the link-control field specifying the TIR function, an 8-bit image-ID count value contained in byte one of the link-control information field, and a logical path field in the link payload. The contents of the link payload shall specify the logical paths that are recognized as being established by the receiver of the extended TIN function, and which correspond to the range of image IDs specified in the received extended TIN function. The image-ID count indicates the range of logical paths contained in the response starting with the control-unit image ID or channel image ID specified in the TIN being responded to and incrementing to the smaller of a) the extent specified by the 8-bit image-ID count value contained in byte one of the link-control information field of the TIN function; or b) a maximum control-unit image or channel image ID of 255. The image-ID count field shall be interpreted as an 8-bit unsigned binary integer and the value in the field may range from 1 to 253. The value in the image-ID count field indicates the number of control-unit images or channel images beyond 1 that were tested and for which results are being provided. (e.g., a count of 3 indicates 4 images were tested). The length of the payload specified by the link-payload byte count contained in the DIB header shall be 32 plus 32 times the value of the image-id count field, and may vary between ~~32~~ 64 and 8128 bytes. (See Table 2 for an example and definition of the format of the logical path field.)

If the channel sends an extended-mode TIR function, the channel image-ID field shall be set to zero by the channel and ignored by the control unit. The control-unit image ID shall be the same as the control-unit image ID received in the extended TIN function. If a control unit sends an extended-mode TIR function, the channel image ID shall be the same as the channel image ID received in the extended TIN function, and the control-unit image ID shall be set to zero by the control unit and ignored by the channel.

An example of the link payload for an extended TIR function which would be returned in response to a TIN function with an image ID field set to zero and an image-ID count field set to 253 is shown in Table 2.

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Table 2 – Logical Path Field - Extended

Word	Contents
0	Logical Paths 0 - 31
1	Logical Paths 32 - 63
2	Logical Paths 64 - 95
3	Logical Paths 96 - 127
4	Logical Paths 128 - 159
5	Logical Paths 160 - 191
6	Logical Paths 192 - 223
7	Logical Paths 224 - 255
8	Logical Paths 256 - 287
9	Logical Paths 288 - 319
. . .	. . ,
2031	Logical Paths 64,992 - 65,023

In the example of Table 3, the logical-path field indicates whether each of the 65,024 logical paths are considered established.

The first 256 bits of the logical path field shall relate to the set of logical paths corresponding to the first source image ID, and continuing, logical paths 256-511 shall correspond to the second source image ID, and subsequent groups of 256 logical paths likewise shall correspond to consecutively increasing source image IDs. The bit for a logical address corresponding to a logical path shall be set to one if that logical path is established and shall be set to zero otherwise.

6.4.8.3 Test Initialization Capability Result Function

The test-initialization-capability result (TINCR) function shall confirm the successful completion of the TINC function and shall indicate the logical paths that the control unit performing the TINCR function is capable of establishing with the channel that sent the TINC function and shall include logical paths that are already established.

Due to resource constraints, a control unit may only be able to establish a subset of the logical paths that it indicates it is capable of establishing at any one time.

The TINCR function shall be performed by sending a TIR IU that specifies the TINCR function. A TINCR function shall be sent only as a response to a TINC function.

When a TINCR function is sent, the link-control DIB shall contain a link header with the link-control field specifying hex '01' and bit 7 of byte zero of the link-control-information field set to one, a logical path field in the link payload, and an 8-bit image-ID count value contained in byte one of the link-control information field. The image-ID count indicates the range of logical paths contained in the response starting with the channel image ID specified in the TINC being responded to and incrementing to the smaller of a) the ~~extent~~ number of images specified by the 8-bit image-ID count value contained in byte one of the link-control information field of the TINC function, or b) a maximum channel image ID of 255. The image-ID count field shall be interpreted as an 8-bit unsigned binary integer and the value in the field may range from 1 to ~~253~~ 254. If the image-ID count value is zero or greater than ~~253~~ 254, a link-level protocol error shall be recognized.

The contents of the link payload shall specify the logical paths that are recognized as being capable of being established by the control that received the TINC function and which correspond to the range of channel image IDs specified in the received TINC function. The length of the payload specified by the link-payload byte count contained in the DIB header shall be 32 times the value of the image-id count field, and may vary between 32 and 8128 bytes (see Table 3 for an example and definition of the format of the logical path field).

The channel image ID in the TINCR shall be the same as the channel image ID received in the TINC function and the control-unit image ID shall be set to zero by the control unit and ignored by the channel.

An example of the link payload for a TINCR function which would be returned in response to a TINC function with an image ID field set to zero and an image-ID count field set to ~~253~~ 254, is shown in Table 3.

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Table 3 – TINCR Logical Path Field

Word	Contents
0	Logical Paths 0 - 31
1	Logical Paths 32 - 63
2	Logical Paths 64 - 95
3	Logical Paths 96 - 127
4	Logical Paths 128 - 159
5	Logical Paths 160 - 191
6	Logical Paths 192 - 223
7	Logical Paths 224 - 255
8	Logical Paths 256 - 287
9	Logical Paths 288 - 319
. . .	. . ,
2031	Logical Paths 64,992 - 65,023

In the example of Table 3, the logical-path field indicates which of the 65,024 logical paths can be established with the control unit, and includes logical paths that are already established.

The first 256 bits of the logical path field shall relate to the set of logical paths corresponding to the first source image ID, and continuing, logical paths 256-511 shall correspond to the second source image ID, and subsequent groups of 256 logical paths likewise shall correspond to consecutively increasing source image IDs. The bit for a logical address corresponding to a logical path shall be set to one if that logical path is capable of being established or is already established with the channel that sent the TINC function; otherwise, the bit shall be set to zero.