

Chapter 24: Communication Protocols

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Overview

This chapter provides information on implementing the ANSI/NCCLS protocols for the BIO-FLASH, including detailed information of the data that the instrument can exchange with laboratory information systems (LIS).

In this chapter, the implementation of the protocols follow, as much as possible, the rules described in the ANSI/NCCLS standards. However, some portions have been edited where the standard does not provide enough detail to complete the implementation.

This chapter covers the following protocols/standards:

- [High level protocol](#):

ANSI/NCCLS LIS2-A-1997; previously designated as ANSI/ASTM E1394-1997, Transferring Information Between Clinical Instruments and Computer Systems, Specification for

- [Low level protocol](#):

ANSI/NCCLS LIS1-A-2002; previously designated as ANSI/ASTM E1381-2002, Low-Level Protocol to Transfer Messages Between Clinical Laboratory Instruments and Computer Systems, Specification for

High Level Protocol

The following topics describe the BIO-FLASH implementation of the high level protocol (ANSI/NCCLS LIS2-A-1997).

Message Structure and Content

Messages consist of a hierarchy of records of various types. In this context:

- A record is an aggregate of fields describing one aspect of the complete message.
- A field is a specific attribute of a record, which can contain aggregates of data elements further refining the basic attribute.

Message Length

The standard does not impose a maximum record length. The instrument implementation restricts the maximum length for incoming messages to 200 KB. Outgoing messages can be of any size.

Records

The hierarchy of records is comprised of several levels. [Table 24-1](#) lists the record types allowed in each level and the hierarchical dependencies between record types.

Table 24-1 Record organization

Level 0	Level 1	Level 2	Level 3	Level 4
Message Header (H)				
	Comment (C)			

Level 0	Level 1	Level 2	Level 3	Level 4
	Request Information (Q)			
		Comment (C)		
	Patient Information (P)			
		Comment (C)		
		Test Order (O)		
			Comment (C)	
			Result (R)	
				Comment (C)
Message Terminator (L)				

Hierarchical Structure Rules

The following are the hierarchical structure rules:

- A message shall be always headed by a message header record (H) and finished by a message terminator record (L).
- An order record (O) may never appear without a preceding patient information record (P).
- A result record (R) may never appear without a preceding order record (O).
- Comment records (C) may be inserted at any level in the hierarchy (except after a message terminator), and it refers to the prior higher-level record.

Example 24-1: Message Structure

```
(Level 0) MESSAGE HEADER
(Level 1)           PATIENT_1
(Level 2)           COMMENT_1
(Level 2)           ORDER_1
(Level 3)           COMMENT_1
(Level 3)           RESULT_1
(Level 3)           RESULT_2
(Level 4)           COMMENT_1
(Level 4)           COMMENT_2
...
(Level 3)           RESULT_N
(Level 2)           ORDER_2
(Level 3)           RESULT_1
(Level 3)           RESULT_2
...
(Level 2)           ORDER_N
(Level 3)           RESULT_N
...
```

```
(Level 1)          PATIENT_2
...
(Level 1)          PATIENT_N
(Level 0) MESSAGE TERMINATOR
```

A sequence of patient information records, order records, or result records at one level, is terminated by the appearance of a record type of the same or higher level.

Fields

In this context, a field is a specific attribute of a record, which can contain aggregates of data elements further refining the basic attribute. There are two kinds of aggregates within a message, the repeat field and the component field.

- Repeat field: A single data element that expresses a duplication of the field definition. Each element of a repeat field has equal priority to associated repeat fields.
- Component field: A single data element or multiple data elements that express a finer aggregate or extension of data elements that precede it.

Example: A patient's name is recorded as last name, first name, and middle initial, each of which is separated by a component delimiter.

Field Length

The standard does not impose a maximum field length and assumes that all fields are variable in length.

The instrument implementation restricts the maximum field length to a specific value depending on the field, but never uses more characters than required by the given field value (according to the standard).

Example: For a 10-character field, only 10 character spaces are used in the message to allow the field content, delimiters space apart.

Character Codes

All data is represented as 8-bit and single-byte values as defined in ISO 8859-1:1987. The 8-bit values within the 0 to 127 range correspond to the ASCII standard character set (ANSI X3.4-1986). Values between 128 and 255 are undefined by this standard and are sent using the code page specified in the instrument configuration.

The use of different code pages allows the exchange of characters from different cultures. Other characters not representable using the specified code page are sent as [escaped characters](#) using UTF-16.

- Allowed characters in the message: 9, 13, 32-126, 128-254
- Disallowed characters in the message: 0-8, 10-12, 14-31, 127, 255

The Latin-1 character 13 is reserved as the record terminator.

Restrictions

The Specimen ID field of the Test Order Records, which appear in some of the transmission scenarios described in [Transmission Scenarios](#) on page 638, cannot contain lowercase characters.

Delimiters

Delimiters establish separate sections within a message. [Table 24-2](#) lists the delimiter types.

Table 24-2 Delimiter types

Delimiter Type	Description
Record	Signals the end of any of the defined record types. Fixed to carriage return character Latin-1 (13) (ASCII 13).
Field	Separates adjacent fields. This delimiter type is configurable and is specified in the message header record. A single character excluding Latin-1 (13) (ASCII 13).
Repeat	Separates a variable number of descriptors for fields that contain parts of equal members of the same set. This delimiter type is configurable and is specified in the message header record. It is comprised of a single character excluding Latin-1 (13) (ASCII 13) and the value used by the field delimiter.
Component	Separates data elements of fields of a hierarchical or qualifier nature. This delimiter type is configurable and is specified in the message header record. It is comprised of a single character excluding Latin-1 (13) (ASCII 13), the value used by the field delimiter, and the value used by the repeat delimiter.
Escape	Signifies special case operations in text fields. This delimiter type is configurable and is specified in the message header record. It has a complex structure, but mainly uses a single character. The character is different from Latin-1 (13) (ASCII 13) and the field, repeat, and component delimiter values.

Considerations

According to the standard, alphanumeric characters should not be used as delimiters. However, the BIO-FLASH implementation allows the use of the following characters as delimiters. (Boundary values included.)

- Any value from ASCII (33) to ASCII (47)
- Any value from ASCII (58) to ASCII (64)
- Any value from ASCII (91) to ASCII (96)
- Any value from ASCII (123) to ASCII (126)

The instrument default delimiters include:

- Field delimiter: vertical bar (|) Latin-1 (124) (ASCII 124)
- Repeat delimiter: at (@) Latin-1 (64) (ASCII 64)
- Component delimiter: caret (^) Latin-1 (94) (ASCII 94)
- Escape delimiter: backslash (\) Latin-1 (92) (ASCII 92)

Fields are identified by their position, obtained by counting field delimiters from the front of the record. This position-sensitive identification procedure requires that, when the contents of the field are null, its

corresponding field delimiter must be included in the record to ensure that the i-th field can be found by counting (i-1) delimiters. Delimiters are not included for trailing null fields.

Escape Sequences

The following escape sequences are predefined:

\H\	Start highlighting text. Ignored by the instrument.
\N\	Normal text (end highlighting). Ignored by the instrument.
\F\	Embedded field delimiter character.
\S\	Embedded component field delimiter character.
\R\	Embedded repeat field delimiter character.
\E\	Embedded escape delimiter character.
\Xhhhh\	Hexadecimal data. See Hexadecimal Escaping below.
\Zcccc\	Local defined escape sequences that send characters not representable in the configured code page. See Local Escape Sequence below.

According to the standard, no escape sequences contain nested escape sequences.

Hexadecimal Escaping

The escaping of standard-disallowed characters occurs when the instrument wants to send a character that is not allowed in the standard. Characters that can be escaped are the ASCII characters 10, 13, 127, 255. In these cases, the character is escaped using hexadecimal escaping. For example, if the instrument wants to send the character 127, it is escaped to \X7F\.

Local Escape Sequence

The local escape sequence is used to exchange characters not representable using the configured code page.

Example

If the instrument wants to send a Japanese character (such as Unicode character U+34C8) using the English code page, the character is lost in a normal transmission because it cannot be represented in the English code page.

To avoid loosing a character, characters that are not representable in the selected code page are escaped using the local escape sequence. In this case, the Japanese character is sent in four hexadecimal digits as \Z34C8\.

Many non-representable code page characters can be added to the same escape sequence.

Specimen Identification

Usually, laboratories reuse specimen IDs every week, every day, or even several times in a day. Reusing specimen IDs means that different patients can have the same specimen ID in different periods. If this period is short enough (for instance, two consecutive days), some specimen management is required.

In these situations, the BIO-FLASH uses one of the following to avoid conflicts:

- An Instrument Specimen ID
- The Instrument Specimen ID plus a Sample Life parameter

Biokit recommends using the Instrument Specimen ID for the following reasons:

- The Instrument Specimen ID is not reused. Therefore, test orders are always properly assigned to the corresponding specimen.
- New tests can be ordered for existing and expired specimen IDs.
- Patient demographics are not compared because the Instrument Specimen ID is not reused and always identifies a specimen.

Specimen ID

Because the LIS host can reuse the Instrument Specimen ID for different patients, the instrument uses the Sample Life parameter to determine whether to add new test orders to an existing specimen.

Test orders received from the LIS are added to **the same** specimen if:

- The time frame since the specimen was created until the test was ordered (Requested/Ordered Date and Time) is lower than the Sample Life.
- and -
- All patient demographic information (first name, last name, birth date, gender, sender ID) is the same.

Test orders received from the LIS are added to a **new** specimen if:

- The time frame since the specimen was created until the test was ordered (Requested/Ordered Date and Time) is greater than or equals the Sample Life.
-or-
- One or more fields of the patient demographic information is different.

Instrument Specimen ID

Using an Instrument Specimen ID allows new test orders to be programmed for existing expired specimens.

The BIO-FLASH generates the Instrument Specimen ID, which the LIS host reuses. You can disable usage of the Instrument Specimen ID through the BIO-FLASH software. If disabled, the instrument does not provide the Instrument Specimen ID to the LIS Host as feedback of incoming test orders.

The Instrument Specimen ID is unique within the scope of one instrument. Although it is almost impossible to reproduce in practice, different specimens might have the same Instrument Specimen ID on different instruments.

If the Instrument Specimen ID is used, no comparison of patient demographics are performed.

If the Instrument Specimen ID received from the LIS does not match any Instrument Specimen ID kept by the BIO-FLASH, test orders are rejected.

Demographic Data

Patient demographics are not updated from the LIS host when specimens are identified using the Specimen ID. They are updated only through the application or from the LIS host when specimens are identified using the Instrument Specimen ID.

Message Transmission Control

The BIO-FLASH implements the following error handling standards.

Error Recovery

To ensure proper error logging and error recovery, the storage rule is followed according to the standard.

Because data content has a hierarchical structure, any decreasing change in the hierarchy level triggers storage of all data transmitted prior to the level change that was not previously saved.

Example 24-2: Storage Rule Implementation

Record #	Record Type	Level	Level Variation	Storage Action
1	Message Header	L0	(0)	
2	Patient1	L1	(+1)	
3	Order1	L2	(+1)	
4	Result1	L3	(+1)	
5	Order2	L2	(-1)	{Save 1 - 4}
6	Order3	L2	(0)	
7	Patient2	L1	(-1)	{Save 5 - 6}
8	Order1	L2	(+1)	
9	Comment1	L3	(+1)	
10	Result1	L3	(0)	
11	Comment1	L4	(+1)	
12	Result2	L3	(-1)	{Save 7 - 11}
13	Order2	L2	(-1)	{Save 12}
14	Patient3	L1	(-1)	{Save 13}
15	Order1	L2	(+1)	
16	Result1	L3	(+1)	
17	Message Terminator	L0	(-3)	{Save 14 - 16}

If a transmission failure occurs, transmission starts at the last record not presumed saved. To fulfill hierarchical record level requirements, all records necessary to reach the restart record point are repeated prior to transmitting the record where the line failure originally occurred.

Example 24-3: Line failure rule

Line Failure Record Type	At	Level (Var)	Storage Action	Retrans Of
1	Message Header	L0 (0)		1
2	Patient1	L1 (+1)		1, 2
3	Order1	L2 (+1)		1, 2, 3
4	Result1	L3 (+1)		1, 2, 3, 4
5	Order2	L2 (-1)	{Save 1 - 4}	1, 2, 3, 4, 5
6	Order3	L2 (0)		1, 2, 5, 6

7	Patient2	L1 (-1)	{Save 5 - 6}	1, 2, 5, 6, 7
8	Order1	L2 (+1)		1, 7, 8
9	Comment1	L3 (+1)		1, 7, 8, 9
10	Result1	L3 (0)		1, 7, 8, 9, 10
11		Comment1 L4 (+1)		1, 7, 8, 9, 10, 11
12	Result2	L3 (-1)	{Save 7 - 11}	1, 7, 8, 9, 10, 11, 12
13	Order2	L2 (-1)	{Save 12}	1, 7, 8, 12, 13
14	Patient3	L1 (-1)	{Save 13}	1, 7, 13, 14
15	Order1	L2 (+1)		1, 14, 15
16	Result1	L3 (+1)		1, 14, 15, 16
17	Message Terminator	L0 (-3)	{Save 14 - 16}	1, 14, 15, 16, 17

Error Messages

Any error that the BIO-FLASH communications module detects is traced in the UDC folder in the Windows Event Viewer (Control Panel > Administrative Tools > Event Viewer). If you have a problem, that is the first place to look for error information.

Optionally, the BIO-FLASH can notify the host of any incorrect message received by the LIS host. If error notification is enabled, the instrument sends messages to the host that contain information about the error (see [Upload message: Request rejected by the instrument](#) on page 663). The instrument distinguishes between syntactic and semantic errors and treats them differently.

Syntactic Errors

Syntactic errors occur when the received message does not follow the general standard rules or the more specific instrument rules.

Table 24-3 Syntactic errors

Error	Description
Invalid message	The incoming message is invalid and the BIO-FLASH does not know what information is being delivered. This can occur when there are invalid characters in the message or when an unexpected message is received. For example, when the instrument receives a response when it has made no request.
Invalid syntax	The incoming message has an invalid syntax. For example, the hierarchy of records is not followed appropriately.
Invalid value	The incoming message has a value that is not supported. Consistency among values in different fields is not checked.
Missing mandatory value	The incoming message does not provide a value for a mandatory field.
Incomplete message	The incoming message is incomplete.

Semantic Errors

Semantic errors are errors that are syntactically correct, but the action cannot be executed by the instrument.

Table 24-4 Semantic errors

Error	Description
Invalid host ID	The host ID received in the message is not the same as the one specified in the instrument. The message is discarded.
Invalid instrument ID	The instrument ID received in the message is not the same as the one specified in instrument. The message is discarded.
Invalid specimen ID	The LIS host sent an specimen ID with invalid characters. Specimen IDs must not contain lowercase characters.
Duplicated test	A test has been received twice. The extraneous test is removed.
Invalid test	The test ordered by the LIS host is unknown. The order is removed.
Disabled or inconsistent test	The test ordered by the LIS host is disabled or is inconsistent. The order is removed.
Invalid instrument specimen ID	The LIS host retrieved an invalid instrument specimen ID. The test is removed.
Invalid specimen ID	The LIS host sent an specimen ID with invalid characters. Specimen IDs must not contain lowercase characters.
Cancellation of pending test request could not be performed	The LIS host can cancel a previously ordered test if it has not yet been executed. This message specifies the test could not be canceled because its execution has started. The result is delivered to the LIS host.
LIS request not allowed	The instrument does not allow the LIS host to perform requests for any data. If a request from the LIS is received, the request is canceled and no data is retrieved.

When an error is found, the instrument skips the wrong part of the message and continues interpreting it as if there is no error. For information on the skipped portion, check the instrument communication tracing system, where you can get the part of the message that was discarded and the reason.

The following rules define the rejected part of the message:

- An error in a header record invalidates the whole message.
- An error in a patient record invalidates all orders below that patient in the hierarchy.
- An error in a order record invalidates only that order record.
- An error in a comment record invalidates only the comment record, but the patient or order record is accepted if more orders or results exist for that patient/order.

Message Storage

If there are hardware or software problems, the BIO-FLASH stores messages that have yet to upload to the LIS. This is to avoid losing messages even if the application closes. If necessary, you can delete all stored messages by clicking the specific button in the communications configuration screen.

The system stores a maximum of 7,200 messages. [Table 24-5](#) describes the system response for different levels of storage capacity.

Table 24-5 Storage capacity alarms

Capacity	System response
75%	The instrument triggers the LIS Message Storage Full alarm, which provides information on the available storage. The alarm also occurs during startup and every time there is a 5% increment or decrement between 75% and 100%.
100%	The instrument triggers the LIS Message Storage Overloaded alarm and storage accepts no more messages. This alarm also occurs every time the communications are restored. The instrument rejects new message uploads and triggers the Upload Message Rejected and LIS Message Storage Overloaded alarms.

Transmission Scenarios

This section lists the possible scenarios for data exchange between the instrument and an LIS host.

Scenarios:

- [Instrument Request Test Orders to Host](#)
- [LIS Host Initiated Test Orders Delivery](#)
- [Host Query Performed by the Instrument](#)
- [Instrument Uploads Instrument Specimen ID to LIS Host](#)
- [Instrument Uploads Test Results](#)
- [LIS Host Request Results to the Instrument](#)
- [Instrument Uploads Error Information](#)

Instrument Request Test Orders to Host

This scenario occurs when the instrument, through a manual or automatic command, launches a request to the LIS host with the intent to download all available test orders.

Messages in this scenario include:

- [Upload message: Test order request performed by the instrument](#)
- [Upload message: Test order request canceled by the instrument](#)
- [Download message: Test order delivery by the LIS host](#)
- [Download message: Test order response when no data available from the LIS host](#)

Upload message: Test order request performed by the instrument

Table 24-6 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Table 24-7 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See Delimiters on page 632
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process the message.	1	String	1	Y	N	P (production)
13	Version No.	Version level of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-8 Request information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	Q
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Starting Range ID Number		3	String		Y	N	ALL
13	Request Information Status Codes		1	String	1	Y	Y	O (req. test order and demogs) N (request new/ edited results)

Table 24-9 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-4: Upload message: Test order request performed by the instrument

```
H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-07 | | | | LIS-HOST-06 | | P | 1394-97 |
200000913174650 <CR>
Q | 1 | ALL | | | | | | | | O@N <CR>
L | 1 | N <CR>
```

Upload message: Test order request canceled by the instrument

The instrument can cancel the last request performed if it has not received any message from the LIS host. The cancellation for the last request allows the instrument to perform another request with higher priority.



Only one request can be performed at a time. The sender cannot transmit another request until the previous one has been answered by the receiver or canceled by the sender. The instrument automatically cancels a request if no answer is received within 60 seconds.

Table 24-10 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Request information (Q)			
		Comment (C)		
Message terminator (L)				

Table 24-11 Message header record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration
12	Processing ID	Indicates how to process this message .	1	String	1	Y	N	P (production)
13	Version No.	Version level of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-12 Request information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	Q
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
13	Request Information Status Codes		1	String	1	Y	N	A (abort last request)

Table 24-13 Comment record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	C
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point.	1	String	1	Y	N	I
4	Comment Text	Comment ID.	1	String	50	N	N	Timeout
		Comment description.	2	String	500	N		Last request was canceled
5	Comment Type	Comment type qualifier.	1	String	1	Y	N	P (information)

Table 24-14 Message terminator record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-5: Upload message: Test order request canceled by the instrument

```
H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-11 | | | | LIS-HOST-93 | | P | 1394-97 |
20010414182154 <CR>
C | 1 | I | timeout ^ last request has been canceled | P <CR>
L | 1 | N <CR>
```

Download message: Test order delivery by the LIS host**Table 24-15** Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
		...		
	...			
Message terminator (L)				

Table 24-16 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to be used throughout the sub- sequent records of the message.	1	String	4	Y	N	See Delimiters on page 632
3	Message ID	Uniquely identifies the message.	1	String	50	N	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		N	N	

Table 24-17 Patient information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as PIR.	1	String	1	Y	N	P
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	Unique processing number assigned to a patient by the lab.	1	String	15	N	N	
6	Patient Name	Patient last name.	1	String	20	N	N	
		Patient first name.	2	String	20	N		
		Patient middle name.	3	String	20	N		
8	Birth date	Date of birth.	1	ANSI/NCCLS Date		N	N	
9	Patient Sex	Sex.	1	String	1	N	N	M (male) F (female) U (unknown)
14	Attending physician ID	ID of the attending physician.	1	String	14	N	N	

Table 24-18 Test order record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	Y	N	
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument. If known, must be retrieved from the LIS.	1	String	30	N	N	
5	Universal Test ID	Instrument defined Test ID.	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R (normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded.	1	ANSI/NCCLS Date		N	N	If empty, set to current date and time
12	Action code	The action to take with the order.	1	String	1	N	Y	A (added in previous specimen or creates a new specimen following the rules of the sample life cycle) C (cancel previous test request)
16	Specimen Descriptor	Specimen type.	5	String	1	Y	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type.
26	Report Type	Intention of the information in the record.	1	String	1	Y	Y	Q (response to query)

Table 24-19 Messsage terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as MTR.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	F (last request processed)

Example 24-6: Download message: Test order delivery by the LIS host

```

H | @ ^ \ |<0_0> <1025080549_50> | | LIS-HOST-03 | | | | INSTR-21 | | P | 1394-97 | 20000614080500
<CR>
P | 1 | | 80501 | | Anderson ^ Jim | | 19800228 | M | | | | 542 <CR>
O | 1 | 6483 | | ^ ^ ^ 211 @ ^ ^ ^ 063 | R | 20000614043211 | | | | A | | | | PLAS | | | | | | |
| | Q <CR>
O | 2 | 8651 | | ^ ^ ^ 310 | S | 20000614043514 | | | | A | | | | PLAS | | | | | | | | | | Q <CR>
P | 2 | | | Foster ^ Rene | | 19740717 | F | | | | 374 <CR>
O | 1 | 0012 | | ^ ^ ^ 512 | R | 20000614044212 | | | | A | | | | PLAS | | | | | | | | | | Q <CR>
O | 2 | 0012 | | ^ ^ . ^ 254 | R | 20000614044325 | | | | A | | | | PLAS | | | | | | | | | | Q <CR>
P | 3 | | | Clinton ^ Jeremy | | 19580223 | M <CR>
O | 1 | 6537 | 310648 | ^ ^ ^ 076 | S | 20000614044212 | | | | A | | | | PLAS | | | | | | | | | |
Q <CR>
O | 2 | 6537 | 310648 | ^ ^ ^ 098 | R | 20000614045021 | | | | C | | | | PLAS | | | | | | | | | |
Q <CR>
O | 3 | 6912 | | ^ ^ ^ 301 @ ^ ^ ^ 357 | R | 20000614052158 | | | | A | | | | PLAS | | | | | | | | |
| | Q <CR>
P | 4 | | | Turner ^ Jim | | 19890821 | M | | | | 271 <CR>
O | 1 | 0509 | 479481 | ^ ^ ^ 002 | | 20000614055734 | | | | C | | | | PLAS | | | | | | | | | |
<CR>
L | 1 | F <CR>
```

Download message: Test order response when no data available from the LIS host

It is possible that there is no information to download. If the LIS host does not transmit anything and the timeout is reached (60 seconds), the instrument assumes that the LIS host has no test orders to program. In that case, the instrument cancels the request as specified in [Upload message: Test order request canceled by the instrument](#) on page 640.



LI recommends that LIS host implementers always provide a response to a request. Otherwise, communication is stopped until the 60-second timeout is reached.

NOTE

Table 24-20 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
Message terminator (L)				

Table 24-21 Message header record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	N	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		N	N	

Table 24-22 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as MTR.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	I (no info from last query)

Example 24-7: Download message: Test order response when no data available from the LIS host

```
H | @ ^ \ | <0_0> <1025080549_50> | | LIS-HOST-04| | | | INSTR-12 | | P | 1394-97 | 20030330033003
<CR>
L | 1 | N <CR>
```

LIS Host Initiated Test Orders Delivery

This scenario occurs when the LIS host decides to download all available test orders to the instrument.

Messages in this scenario include:

- Download message: LIS host initiated test order delivery

Download message: LIS host initiated test order delivery

Table 24-23 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
		...		
	...			
Message terminator (L)				

Table 24-24 Message header record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	N	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		N	N	

Table 24-25 Patient information record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as PIR.	1	String	1	Y	N	P
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	Unique processing number assigned to a patient by the lab.	1	String	15	N	N	
6	Patient Name	Patient last name.	1	String	20	N	N	
		Patient first name.	2	String	20	N		
		Patient middle name.	3	String	20	N		
8	Birth date	Date of birth.	1	ANSI/NCCLS Date		N	N	
9	Patient Sex	Sex.	1	String	1	N	N	M (male) F (female) U (unknown)
14	Attending Physician ID	ID of the attending physician.	1	String	14	N	N	

Table 24-26 Test order record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	Y	N	
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument.	1	String	30	N	N	
5	Universal Test ID	Instrument defined Test ID.	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R (normal)

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
7	Requested/Ordered Date and Time	Date and time the order was received or recorded.	1	ANSI/NCCLS Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and time
12	Action code	The action to take with the order.	1	String	1	N	Y	A (added in previous specimen or creates a new specimen following the rules of the sample life cycle) C (cancel a previous test request)
16	Specimen Descriptor	Specimen type.	1	String	1	Y	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type.

Table 24-27 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	Y	N	
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument.	1	String	30	N	N	
5	Universal Test ID	Instrument-defined test ID.	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R (normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded.	1	ANSI/NCCLS Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and time

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
12	Action code	The action to take with the order.	1	String	1	N	Y	A (added in previous specimen or creates a new specimen following the rules of the sample life cycle) C (cancel a previous test request)
16	Specimen Descriptor	Specimen type.	1	String	1	Y	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type.
26	Report Type	Intention of the information in the record.	1	String	1	Y	Y	O (order record)

Table 24-28 Message terminator record field number

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-8: Download message: LIS host initiated test order delivery

```

H | @ ^ \ | <0_0> <1025080549_50> | | LIS-HOST-11 | | | | INSTR-09 | | P | 1394-97 |
20000715180000 <CR>
P | 1 | | | Dillon ^ Jennifer | | 19820414 | F <CR>
O | 1 | 8201 | | ^ ^ ^ 900 | S | 20000715143243 | | | | N | | | | PLAS | | | | | | | | O <CR>
O | 2 | 8201 | | ^ ^ ^ 444 @ ^ ^ ^ 666 | R | 20000715143725 | | | | N | | | | PLAS | | | | | | | |
| O <CR>
P | 2 | | | Carter ^ Rudy | | 19620121 | F | | | | 985 <CR>
O | 1 | 5438 | 690008 | ^ ^ ^ 369 | R | 20000715143912 | | | | A | | | | PLAS | | | | | | | |
O <CR>
O | 2 | 5438 | 690008 | ^ ^ ^ 963 | R | 20000715144127 | | | | A | | | | PLAS | | | | | | | |
O <CR>
P | 3 | | | Stendal ^ Jeremy | | 19321002 | M <CR>
O | 1 | 5009 | 324879 | ^ ^ ^ 209 | | 20010913215702 | | | | C | | | | PLAS | | | | | | | |
<CR>
L | 1 | N <CR>
```

Host Query Performed by the Instrument

This scenario occurs when you perform the host query functionality in the instrument. Host query allows selective downloading of test orders, taking as input a single or set of specimen IDs (sample IDs).

Messages in this scenario include:

- [Upload message: Host query performed by the instrument](#)
- [Upload message: Test order request canceled by the instrument](#)
- [Download message: Host query response from LIS host](#)

Upload message: Host query performed by the instrument

Table 24-29 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Table 24-30 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-31 Request information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	Q
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Starting Range ID Number	Specimen ID.	2	String	16	Y	Y	
		Instrument specimen ID.	3	String	30	N	Y	
13	Request Information Status Codes		1	String	1	Y	Y	O (req. test order and demogs) N (request new test orders still not downloaded)

Table 24-32 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-9: Upload message: Host query performed by the instrument

H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-03 | | | | LIS-HOST-04 | | P | 1394-97 |
19990913174650 <CR>
Q | 1 | ^ 4243 ^ 876271 @ ^ 0434 @ ^ 0435 @ ^ 6742 ^ 878432 | | | | | | | | O@N <CR>
L | 1 | N <CR>

Upload message: Test order request canceled by the instrument

See [Upload message: Test order request canceled by the instrument](#) on page 640.

Download message: Host query response from LIS host

The LIS host retrieves data for the specified specimen IDs (see [Download message: Test order delivery by the LIS host](#) on page 642). If, in a multiple host query there are specimens that have pending orders and there are others that do not, the host query response has to retrieve the pending specimens only. The instrument assumes that there are no orders for the specimens not listed in the host query response.

If the LIS host does not have anything to answer, because it does not know the specimen IDs or because there are no test orders to retrieve, it must follow the same rules described in [Download message: Test order response when no data available from the LIS host](#) on page 645.

Instrument Uploads Instrument Specimen ID to LIS Host

This scenario occurs when the instrument receives a list of test orders from the LIS host. For every new specimen received, the instrument generates an internal specimen ID (an Instrument Specimen ID) and sends it back to the LIS host.

Future LIS host references to these specimens are performed using both identifiers: Specimen ID and Instrument Specimen ID. In the same way, all information sent back to the LIS host by the instrument is accompanied by both identifiers.

This scenario can be launched after tests orders are delivered to the instrument.

Messages in this scenario include:

- Upload message: Instrument uploads instrument specimen ID to LIS host

Upload message: Instrument uploads instrument specimen ID to LIS host

Table 24-33 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
	...			
Message terminator (L)				

Table 24-34 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-35 Patient information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as PIR.	1	String	1	Y	N	P
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	Unique processing number assigned to a patient by the lab.	1	String	15	N	N	
6	Patient Name	Patient last name.	1	String	20	N	N	
		Patient first name.	2	String	20	N		
		Patient middle name.	3	String	20	N		
8	Birth date	Date of birth.	1	ANSI/NCCLS Date		N	N	
9	Patient Sex	Sex.	1	String	1	N	N	M (male) F (female) U (unknown)
14	Attending Physician ID	ID of the attending physician.	1	String	14	N	N	

Table 24-36 Test order record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	Y	N	
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument.	1	String	30	Y	N	

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
5	Universal Test ID	Instrument defined Test ID.	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R (normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded.	1	ASTM Date		N	N	If empty, Requested/Ordered Date and Time is set to current date and time.
12	Action code	The action to take with the order.	1	String	1	Y	Y	P (pending specimen)
16	Specimen Descriptor	Specimen type.	1	String	1	Y	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type.
26	Report Type	Intention of the information in the record.	1	String	1	Y	Y	O (order record) I (pending in instrument)

Table 24-37 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-10: Upload message: Instrument uploads instrument specimen ID to LIS host

```
H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-21 | | | | LIS-HOST-03 | | P | 1394-97 |
20000614080624 <CR>
P | 1 | | | Anderson ^ Jim | | 19800228 | M | | | | 542 <CR>
O | 1 | 6483 | 312890 | ^ ^ ^ 063 | R | 20000614043211 | | | | P | | | | PLAS | | | | | | |
O@I <CR>
P | 2 | | | Foster ^ Rene | | 19740717 | F | | | | 374 <CR>
O | 1 | 0012 | 312892 | ^ ^ ^ 512 | R | 20000614044212 | | | | P | | | | PLAS | | | | | | |
O@I <CR>
L | 1 | N <CR>
```

Instrument Uploads Test Results

This scenario occurs when the instrument receives a request to send available test results to the LIS host. This scenario is executed when the action is triggered manually or automatically. This scenario is not

triggered by a request from the LIS host. The instrument does not support a request message for test result uploads.

Messages in this scenario include:

- [Upload message: Test results delivery carried out by the instrument](#)
- [Download message: Test results delivery rejected by the LIS host](#)

Upload message: Test results delivery carried out by the instrument

Table 24-38 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
			Result (R)	
				Comment (C)
				...
				...
				...
Message terminator (L)				

Table 24-39 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-40 Patient information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as PIR.	1	String	1	Y	N	P
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	Unique processing number assigned to a patient by the lab.	1	String	15	N	N	
6	Patient Name	Patient last name.	1	String	20	N	N	
		Patient first name.	2	String	20	N		
		Patient middle name.	3	String	20	N		
8	Birth date	Date of birth.	1	ANSI/NCCLS Date		N	N	
9	Patient Sex	Sex.	1	String	1	N	N	M (male) F (female) U (unknown)
14	Attending physician ID	ID of the attending physician.	1	String	14	N	N	

Table 24-41 Test order record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	Y	N	

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument.	1	String	30	N	N	
5	Universal Test ID	Instrument-defined test ID.	4	Numeric	6	Y	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R (normal)
7	Requested/ Ordered Date and Time	Date and time the order was received or recorded.	1	ASTM Date		N	N	
12	Action code	The action to take with the order.	1	String	1	N	N	Q (mandatory when quality control)
16	Specimen Descriptor	Specimen type.	1	String	1	Y	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type or QC for quality control results.
26	Report Type	Intention of the information in the record.	1	String	1	Y	Y	O (order record) F (all tests results are final or could not be done - see R9) P (this test triggers a rerun)

Table 24-42 Result record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	R
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
3	Universal Test ID	Instrument defined Test ID.	4	Numeric		Y	N	0 - 999999999
4	Data or Measurement Value	Observed, calculated or implied result value.	1	String	30	N	Y	
5	Units	Abbreviation of units for numerical results.	1	String	15	N	Y	For information on specific unit values see section 6.

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
7	Result Abnormal Flags	Indicates the normalcy status of the result.	1	String	2	Y	N	L (below low normal) H (above high normal) N (normal) < (below absolute low) > (above absolute high)
9	Result Status		1	String	1	Y	Y	F (final result) P (preliminary result, because a rerun has been set) V (result validated) X (result cannot be done)
11	Operator Identification	Operator ID for the test performer.	1	String	30	N	N	
		Operator ID for the test verifier.	2	String	30	N		
13	Date Time Test Completed	Date and time the instrument completed the test.	1	ASTM Date		Y	N	
14	Instrument Identification	Identifies the instrument that performed the measurement.	1	String	14	Y	N	Instrument ID as specified in the instrument.
		Rack ID.	2	String	2	Y	N	
		Rack position.	3	String	2	Y	N	

Table 24-43 Comment record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	C
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point.	1	String	1	Y	N	I
4	Comment Text	Comment ID.	1	String	50	N	N	
		Comment description.	2	String	500	N		
		Comment area.	3	String	50	N		

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
5	Comment Type	Comment type qualifier.	1	String	1	Y	N	I (instrument flag comment) N (negative comment)

Table 24-44 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-11: Upload message: Test results delivery carried out by the instrument

```
H | @^ \ | 123 | | INSTR-52 | | | | LIS-HOST-31 | | P | 1394-97 | 20000614060520 <CR>
P | 1 | | | | | | | | | | <CR>
O | 1 | Normal Control | <1034241923_260> | ^ ^ ^ 555 | R | | | | | | | | | | PLAS | | | | | | | |
| O @ F <CR>
R | 1 | ^ ^ ^ 555 | 106.01 | % | | N | | F @ V | | ^ OP1 | | 20021211163215 | INSTR-21 ^ B ^ 5 <CR>
C | 1 | I | 1025 ^ reagent temperature warning ^ HW | I <CR>
C | 2 | I | 1030 ^ cuvette shuttle temp warning ^ HW | I <CR>
R | 2 | ^ ^ ^ 555 | 12.65 | sec | | N | | F @ V | | ^ OP1 | | 20021211163215 | INSTR-21 ^ F ^ 3 <CR>
R | 3 | ^ ^ ^ 555 | 0.97 | INR | | L | | F @ V | | ^ OP1 | | 20021211163215 | INSTR-21 ^ G ^ 2 <CR>
C | 1 | I | 1017 ^ probe temperature warning ^ HW | I <CR>
L | 1 | N <CR>
```

Download message: Test results delivery rejected by the LIS host

If there is an error in the information retrieved by the instrument to the LIS host, the LIS host cannot retrieve any error information to the instrument.

LIS Host Request Results to the Instrument

This scenario occurs when the LIS host sends a request to the instrument to upload available test results. The BIO-FLASH does not support this operation. Consequently, all requests for test results received from LIS host are rejected.

Messages in this scenario include:

- [Download message: Test results request performed by the LIS host](#)
- [Upload message: Request rejected by the instrument](#)

Download message: Test results request performed by the LIS host**Table 24-45** Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Request information (Q)			
Message terminator (L)				

Table 24-46 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	N	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process the message.	1	String	1	Y	N	P (production)
13	Version No.	Version level of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		N	N	

Table 24-47 Request information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	Q
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
13	Request Information Status Codes		1	String	1	Y	Y	C (correction of previous values) P (preliminary results) F (final results) X (results cannot be done) I (request results pending) S (request partial results) R (result previously transmitted) A (abort last request) N (request new/edit results) O (request tests and demog data) D (request demographic data only)

Table 24-48 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-12: Download message: Test results request performed by the LIS host

```
H | @ ^ \ | <0_0> <1025080549_50> | | LIS-HOST-05 | | | | INSTR-17 | | P | 1394-97 |
20010518123841 <CR>
Q | 1 | ALL | | | | | | | | I <CR>
L | 1 | N <CR>
```

Upload message: Request rejected by the instrument**Table 24-49** Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Comment (C)			
Message terminator (L)				

Table 24-50 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-51 Comment record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	C
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point.	1	String	1	Y	N	I

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
4	Comment Text	Comment ID.	1	String	50	N	N	invalidTransmissionInformation
		Comment description.	2	String	500	N		Request not allowed.
5	Comment Type	Comment type qualifier.	1	String	1	Y	N	N (negative result/error info)

Table 24-52 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as MTR.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	Q (error in last request)

Example 24-13: Upload message: Request rejected by the instrument

```
H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-02 | | | | LIS-HOST-01 | | P | 1394-97 |
20020421073718 <CR>
C | 1 | I | invalidTransmissionInformation ^ Request not allowed | N <CR>
L | 1 | N <CR>
```

Instrument Uploads Error Information

This scenario occurs when the instrument receives an invalid message from the LIS host. For more information, see [Message Transmission Control](#) on page 635.

Messages in this scenario include:

- [Upload message: Error information message \(1\)](#)
- [Upload message: Error information message \(2\)](#)

Upload message: Error information message (1)

This message is retrieved when there is a syntactic error or when the host ID or instrument ID does not match the values configured in the instrument.

Table 24-53 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Comment (C)			
Message terminator (L)				

Table 24-54 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Defines the delimiters to use throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration.
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration.
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated.	1	ANSI/NCCLS Date		Y	N	

Table 24-55 Comment record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	C
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point.	1	String	1	Y	N	I
4	Comment Text	Comment ID.	1	String	50	N	N	invalidMessage invalidSyntax invalidValue missing-MandatoryValue incompleteMessage invalidTransmissionInformation
			2	String	500	N		
5	Comment Type	Comment type qualifier.	1	String	1	Y	N	N (negative result/error info)

Table 24-56 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	E (unknown system error)

Example 24-14: Upload message: Error information message (1)

```
H | @ ^ \ | <0_0> <1025080549_50> | | INSTR-02 | | | | LIS-HOST-01 | | P | 1394-97 |
20020421073718 <CR>
C | 1 | I | InvalidTransmissionInformation ^ Invalid host ID | N <CR>
L | 1 | N <CR>
```

Upload message: Error information message (2)

This message is retrieved when there is an action that the instrument cannot execute.

Table 24-57 Message structure

Level 0	Level 1	Level 2	Level 3	Level 4
Message header (H)				
	Patient Information (P)			
		Test Order (O)		
			Comment (C)	
Message terminator (L)				

Table 24-58 Message header record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	H
2	Delimiter Definition	Define the delimiters to be used throughout the subsequent records of the message.	1	String	4	Y	N	See section 2.4 for more information
3	Message ID	Uniquely identifies the message.	1	String	50	Y	N	
5	Sender Name or ID	Name or ID of the sender.	1	String	14	Y	N	The value defined in the instrument configuration

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
10	Receiver ID	Name or ID of the receiver.	1		14	Y	N	The value defined in the instrument configuration
12	Processing ID	Indicates how to process this message.	1	String	1	Y	N	P (production)
13	Version No.	Version of the current specification.	1	String	7	Y	N	LIS2-A-1997
14	Date and Time of Message	Date and time the message was generated	1	ANSI/NCCLS Date		Y	N	

Table 24-59 Patient information record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record as PIR.	1	String	1	Y	N	P
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n
4	Laboratory patient ID	Unique processing number assigned to a patient by the lab.	1	String	15	N	N	
6	Patient Name	Patient last name.	1	String	20	N	N	
		Patient first name.	2	String	20	N		
		Patient middle name.	3	String	20	N		
8	Birth date	Date of birth.	1	ASTM Date		N	N	
9	Patient Sex	Sex.	1	String	1	N	N	M (male) F (female) U (unknown)
14	Attending physician ID	ID of the attending physician.	1	String	14	N	N	

Table 24-60 Test order record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	O
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	Numeric		Y	N	1,2,3 ... n

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
3	Specimen ID	Unique identifier for the specimen assigned by the host.	1	String	16	N	N	
4	Instrument Specimen ID	Unique identifier for the specimen assigned by the instrument.	1	String	30	N	N	
5	Universal Test ID	Instrument-defined Test ID.	4	Numeric	6	N	Y	0 - 999999
6	Priority		1	String	1	N	N	S (stat) R(normal)
7	Requested/Ordered Date and Time	Date and time the order was received or recorded.	1	ASTM Date		N	N	
16	Specimen Descriptor	Specimen type.	1	String	1	N	N	Any POCT1-A table 51 code (see Specimen Type Field Values on page 673). Also configured in the instrument as possible specimen type.
26	Report Type	Intention of the information in the record.	1	String	1	N	Y	O (order record) X (order cannot be done), Y (no order/test in record)

Table 24-61 Comment record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	C
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String		Y	N	1,2,3 ... n
3	Comment Source	Comment origination point.	1	String	1	Y	N	I
4	Comment Text	Comment ID.	1	String	50	N		invalidDemographicData invalidSpecimenData invalidTestData duplicatedTest
		Comment description.	2	String	500	N		
5	Comment Type	Comment type qualifier.	1	String	1	Y	N	N (negative result/error info)

Table 24-62 Message terminator record

Field No.	Field Name	Description	Part	Data Type	Max. Length	Req.	Allow Repeat	Allowed Values
1	Record Type ID	Identifies the record.	1	String	1	Y	N	L
2	Sequence Number	Defines the i-th occurrence of the associated record type.	1	String	1	Y	N	1
3	Termination Code	Provides an explanation of end of session.	1	String	1	Y	N	N (normal termination)

Example 24-15: Upload message: Error information message (2)

```
H | @ ^ \ | 123 | | INSTR-02 | | | | LIS-HOST-01| | P | 1394-97 | 20020421073718 <CR>
P | 1 | | | | | | | | | | <CR>
O | 1 | 8642 | | ^ ^ ^ 1234 | R | | | | | | | | PLAS | | | | | | | | O @ Y <CR>
C | 1 | I | invalidTestData ^ duplicated test | N <CR>
L | 1 | N <CR>
```

Transmission Scenario Relationships

Figure 24-1 Manual or automatic job orders downloading

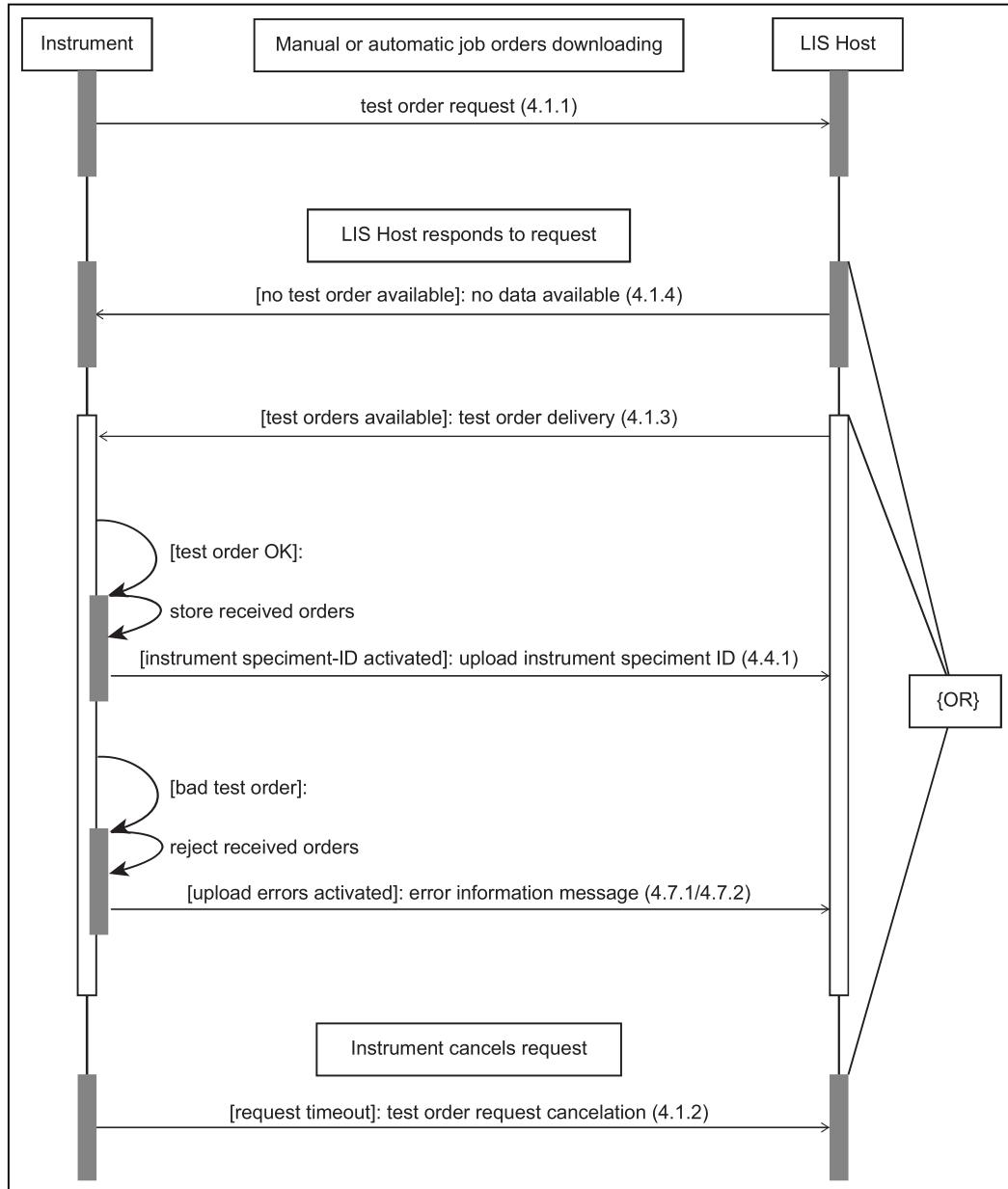


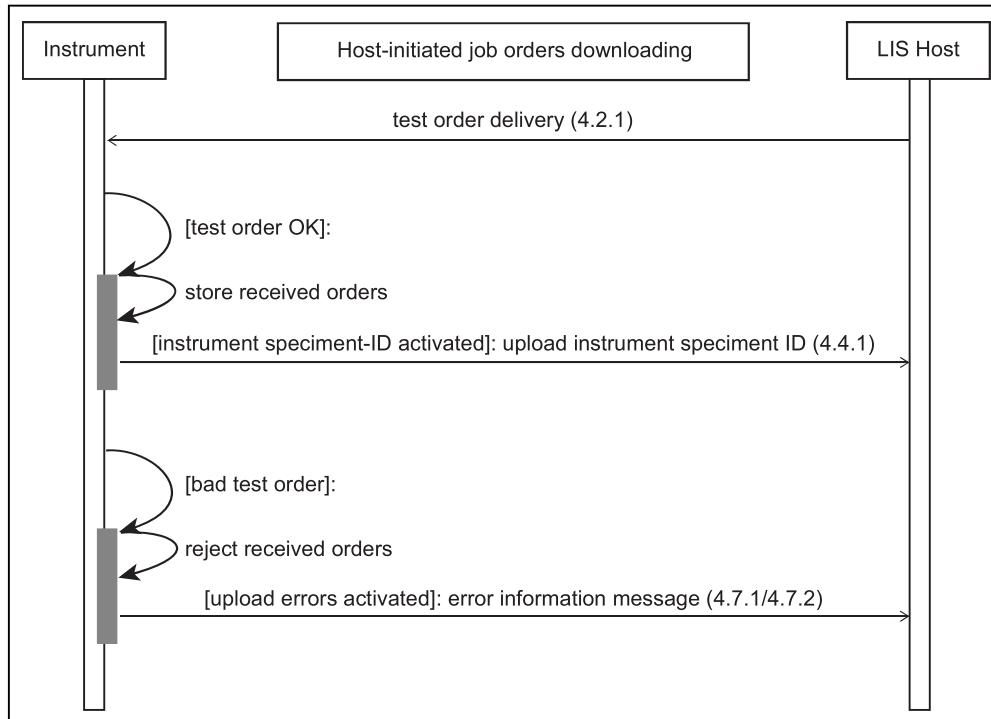
Figure 24-2 Host-initiated job orders downloading

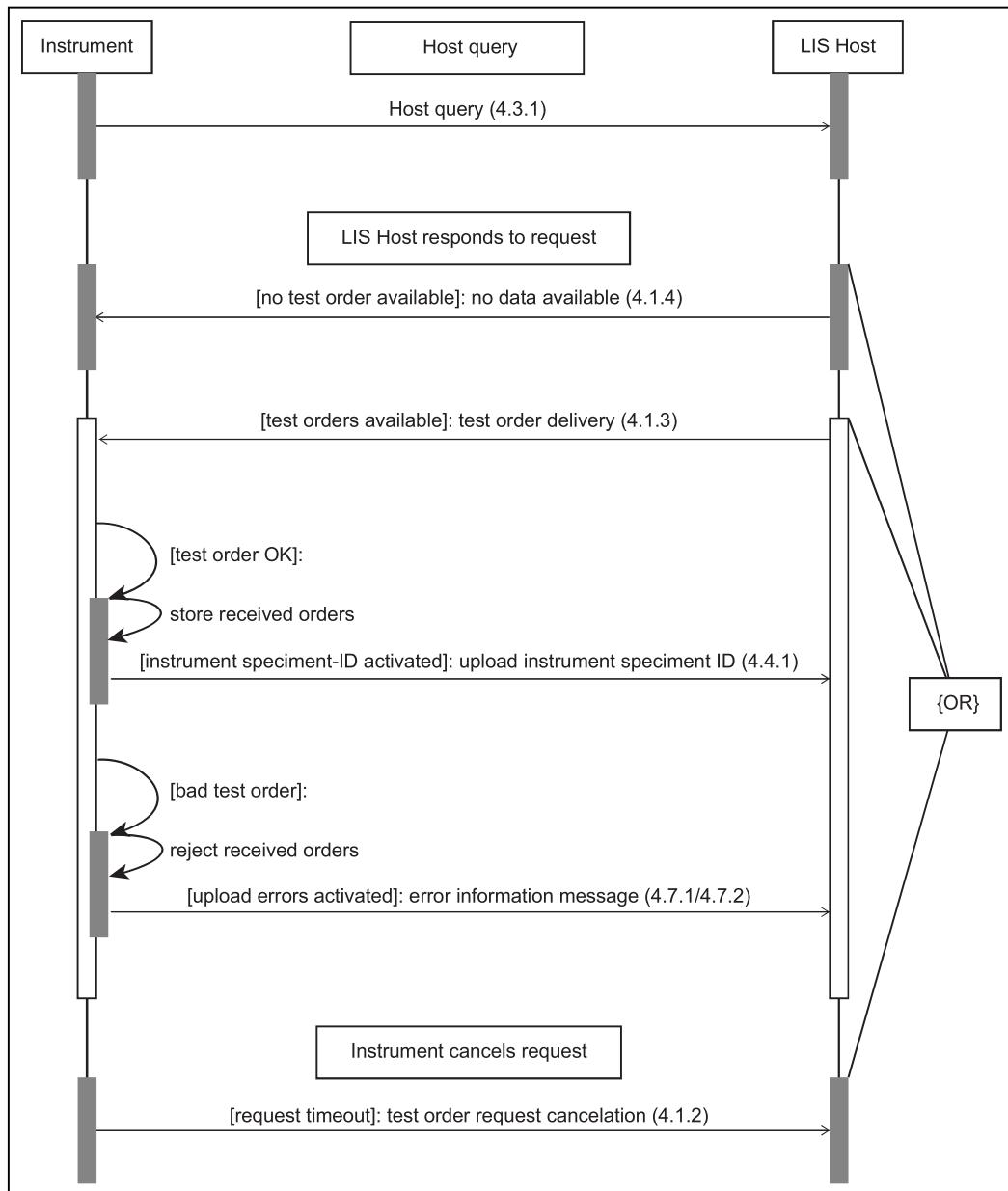
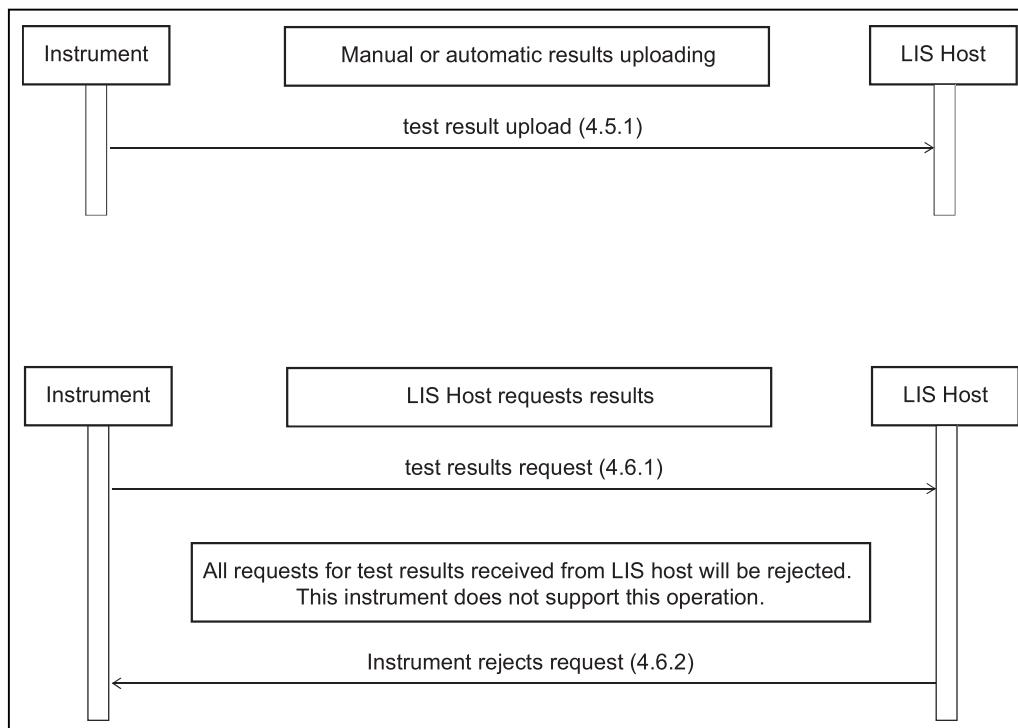
Figure 24-3 Host query

Figure 24-4 Manual or automatic job results uploading

Specimen Type Field Values

[Table 24-63](#) lists the specimen descriptor codes that apply to this implementation.

Table 24-63 Specimen type field values

Code	Description	Code	Description	Code	Description
ABS	Abscess	FIST	Fistula	SER	Serum
AMN	Amniotic fluid	FLT	Filter	SKM	Skeletal muscle
ASP	Aspirate	FLU	Body fluid, unspecified	SKN	Skin
BBL	Blood bag	GAS	Gas	SMN	Seminal fluid
BDY	Whole body	GAST	Gastric fluid/contents	SNV	Synovial fluid (joint fluid)
BIFL	Bile fluid	GEN	Genital	SPRM	Spermatozoa
BLD	Whole blood	GENC	Genital cervix	SPT	Sputum
BLDA	Blood arterial	GENL	Genital lochia	SPTC	Sputum - coughed
BLDC	Blood capillary	GENV	Genital vaginal	SPTT	Sputum - tracheal aspirate
BLDCO	Cord blood	HAR	Hair	STL	Stool (fecal)
BLDV	Blood venous	IHG	Inhaled Gas	STON	Stone (use CALC)
BLMV	Blood mixed venous	ISLT	Isolate	SWT	Sweat
BON	Bone	IT	Intubation tube	TEAR	Tears

Code	Description	Code	Description	Code	Description
BPH	Basophils	LAM	Lamella	THRB	Thrombocyte (platelet)
BPU	Blood product unit	LIQ	Liquid NOS	THRT	Throat
BRN	Burn	LN	Line	TISG	Tissue gall bladder
BRO	Bronchial	LNA	Line arterial	TISPL	Tissue placenta
BRTH	Breath (use EXHLD)	LNV	Line venous	TISS	Tissue
CALC	Calculus (stone)	LYM	Lymphocytes	TISU	Tissue ulcer
CDM	Cardiac muscle	MAC	Macrophages	TLGI	Tissue large intestine
CNJT	Conjunctiva	MAR	Marrow	TLNG	Tissue lung
CNL	Cannula	MBLD	Menstrual blood	TSMI	Tissue small intestine
COL	Colostrum	MEC	Meconium	TUB	Tube NOS
CSF	Cerebral spinal fluid	MILK	Breast milk	ULC	Ulcer
CTP	Catheter tip	MLK	Milk	UMB	Umbilical blood
CUR	Curettage	NAIL	Nail	UMED	Unknown medicine
CVM	Cervical mucus	NOS	Nose (nasal passage)	UR	Urine
CVX	Cervix	ORH	Other	URC	Urine clean catch
CYST	Cyst	PAFL	Pancreatic fluid	URNS	Urine sediment
DIAF	Dialysis fluid	PAT	Patient	URT	Urine catheter
DOSE	Dose med or substance	PLAS	Plasma	URTH	Urethra
DRN	Drain	PLB	Plasma bag	USUB	Unknown substance
DUFL	Duodenal fluid	PLC	Placenta	VITF	Vitreous fluid
EAR	Ear	PLR	Pleural fluid (thoracentesis fld)	VOM	Vomitus
EARW	Ear wax (cerumen)	PMN	Polymorphonuclear neutrophils	WAT	Water
ELT	Electrode	PPP	Platelet poor plasma	WBC	Leukocytes
ENDC	Endocardium	PRP	Platelet rich plasma	WICK	Wick
ENDM	Endometrium	PRT	Peritoneal fluid/ascites	WND	Wound
EOS	Eosinophils	PUS	Pus	WNDA	Wound abscess
EXG	Exhaled gas (breath)	RBC	Erythrocytes	WNDD	Wound drainage
EYE	Eye	RT	Route of medicine	WNDE	Wound exudate
FIB	Fibroblasts	SAL	Saliva		

Low Level Protocol

The following topics describe the BIO-FLASH implementation of the low level protocol (ANSI/NCCLS LIS1-A-2002).

Physical Layer

The BIO-FLASH can connect to an external system using an RS-232 serial connector or an RJ-45 network connector using sockets.

Serial Connection

This section describes issues related to the mechanical and electrical connection between the BIO-FLASH and the LIS. The topology is a direct point-to-point connection, matching the physical layer definition in the ISO reference model for Open Systems Interconnection.



See ISO/IEC 7498-1:1994 Information technology - Open Systems Interconnection - Basic Reference Model: The Basic Model.

Character Structure

The method of data transmission is serial-by-bit start-stop. The default character structure consists of one start bit, eight data bits, no parity bit, and one stop bit.

Table 24-64 Configurable bit sections

Bit sections	Parameter	Allowed values
Data bits	Number of data bits coding a character	8, 7
Parity bit	Parity type	No parity, odd, even, mark, space
Stop bits	Number of stop bits	1, 2

Speed (Baud Rate)

You can configure the data transmission rate for the BIO-FLASH. The default baud rate is 9600 baud.

Table 24-65 Baud rate

Baud rate	300	1200	2400	4800	9600	19200	38400
	57600	115200					

Interface Connections

The BIO-FLASH serial port is a PC-standard DB-25 (EIA/TIA 232-E) or a DB-9 (EIA/TIA 574) male connector (both RS-232 connectors).

[Table 24-66](#) lists the pin assignments for a standard PC serial communications interface. The ports are wired as data terminal equipment (DTE).

Table 24-66 Serial connector pin assignments

Mnemonics	EIA/TIA Name	CCIT V.24	Signal direction	DB-9	DB-25	Description	Used by the Instrument
TD	BA	103	Out	3	2	Transmitted Data	Yes
RD	BB	104	In	2	3	Received Data	Yes
RTS	CA/CJ	105/133	Out	7	4	Request To Send	Yes
CTS	CB	106	In	8	5	Clear To Send	Yes
DSR	CC	107	In	6	6	Data Ready Set	Yes
SG	AB	102	-	5	7	Signal Ground	Yes
DCD	CF	109	In	1	8	Carrier Detect	No
DTR	CD	108/1, /2	Out	4	20	Data Terminal Ready	Yes

Serial Ports

The BIO-FLASH allows one of the following serial ports: COM1, COM2, COM3, or COM4.

Data Link Layer

This section describes the implementation of the services in the Data link and Transport layers in the ISO reference model for Open Systems Interconnection.

The data link layer procedures include:

- **Link connection and release**—enables and disables (respectively) the system for sending and receiving information.
- **Delimiting and synchronizing**—provides for data framing and frame recognition.
- **Sequence control**—maintains the sequential order of information across the connection.
- **Error detection**—senses transmission or format errors.
- **Error recovery**—attempts to recover from detected errors by retransmitting defective frames or returning the link to a neutral state from otherwise unrecoverable errors.

Because this protocol works over a point-to-point topology, network services are not required.

The data link layer uses a character-oriented protocol to send messages between directly connected systems.

The mode of operation is a one-way transfer of information with alternate supervision. Information flows in one direction at time. Replies occur after information is sent, never at the same time. It is a simplex stop-and-wait protocol.

There are three distinct phases in transferring information between instrument and the computer system; establishment, transfer, and termination. In each phase, one system directs the operation and is responsible for continuity of the communication. Distinct phases assure that the actions of the sender and the receiver are coordinated.

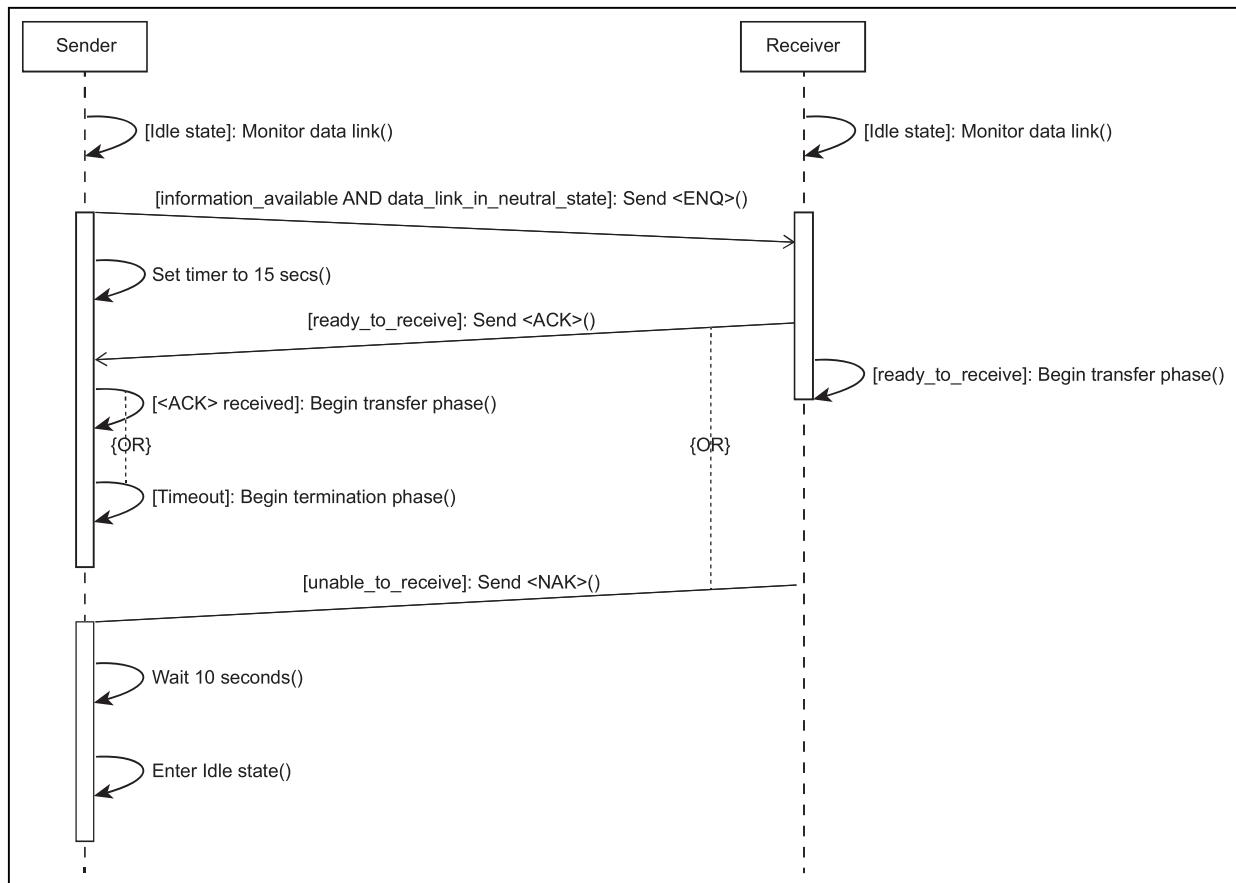
Establishment Phase – Link Connection

The establishment phase determines the direction of the information flow and prepares the receiver to accept the information.

Operation

The sender sends an <ENQ> to notify the receiver that information is available. The receiver responds with an <ACK>, which indicates that it is prepared to receive. A receiver that cannot immediately receive information replies to the sender with a <NAK> transmission control character.

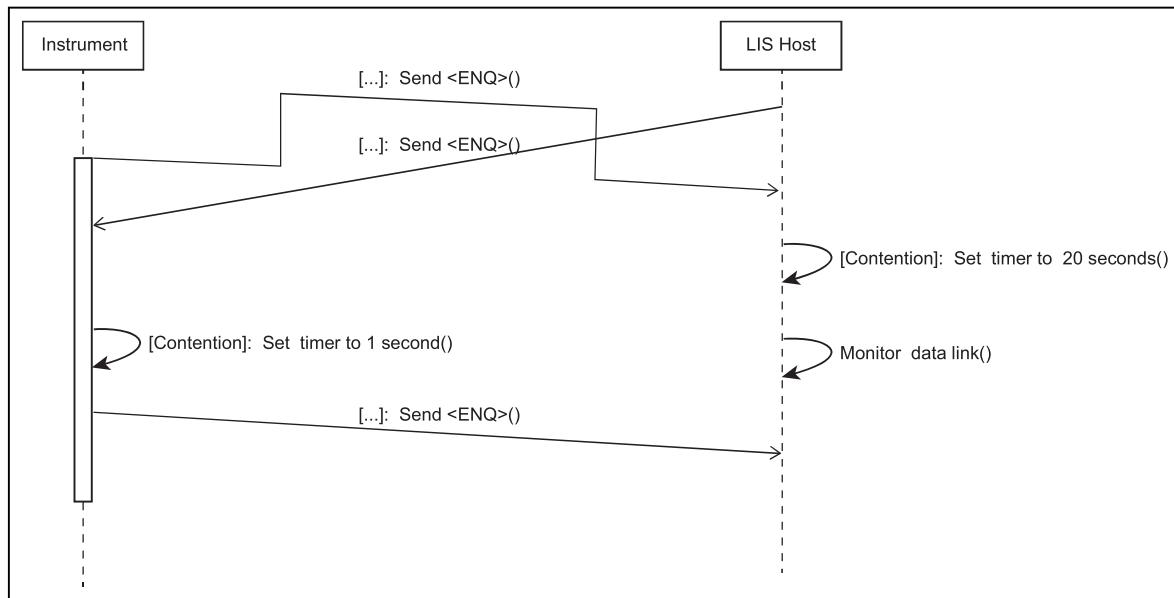
Figure 24-5 Receiver replies to the sender with a <NAK>



A system that does not have information to send normally monitors the data link to detect the establishment phase. It acts as a receiver, waiting for connections of the other system.

Contention

Contention occurs when both systems (instrument and LIS host) simultaneously try to establish link connection by transmitting an <ENQ> transmission control character. When contention occurs, the instrument has priority.

Figure 24-6 Contention over <ENQ> transmissions

Transfer Phase

During the transfer phase, the sender transmits messages to the receiver until all messages are sent. Messages are sent in frames.

Frames

Each frame contains a maximum of 247 characters (240 characters including message text and 7 control characters).

Messages with text longer than 240 characters are divided between two or more frames.

Multiple messages are never merged in a single frame or connection. Every message must begin in a new frame.

There are two kinds of frames: intermediate frames and end frames. The only difference relies on one transmission control character, but they are semantically different.

- Intermediate frame parts: <STX> FN Text <ETB> C1 C2 <CR> <LF>
- End frame parts: <STX> FN Text <ETX> C1 C2 <CR> <LF>

A message that contains 240 characters or less is sent in a single end frame. Longer messages are sent in intermediate frames with the last part of the message sent in an end frame.

Each message is transmitted in a new connection. This means that the instrument never sends two consecutive messages without restarting the connection with an <ENQ>.

[Table 24-67](#) lists descriptions for the parts of the frames.

Table 24-67 Frame parts

Frame parts	Frame part description
<STX>	Start of text transmission control character.
FN	Frame number (single digit comprised in the range 0-7). See Frame Number .

Frame parts	Frame part description
Text	Data content of message.
<ETB>	End of transmission block transmission control character.
<ETX>	End of text transmission control character.
C1	Most significant character of checksum (belonging to {0-9, A-F}). See Checksum .
C2	Least significant character of checksum (belonging to {0-9, A-F}). See Checksum .
<CR>	Carriage return ASCII character.
<LF>	Line feed ASCII character.

Frame Number

The frame number (FN) enables the receiver to distinguish between new and retransmitted frames.

The frame number begins at 1 with the first frame of the transfer phase. The frame number increments by one for every new frame transmitted. After 7, the frame number rolls over to 0, and continues in this fashion.

Checksum

The checksum enables the receiver to detect a defective frame. The checksum is encoded as two characters.

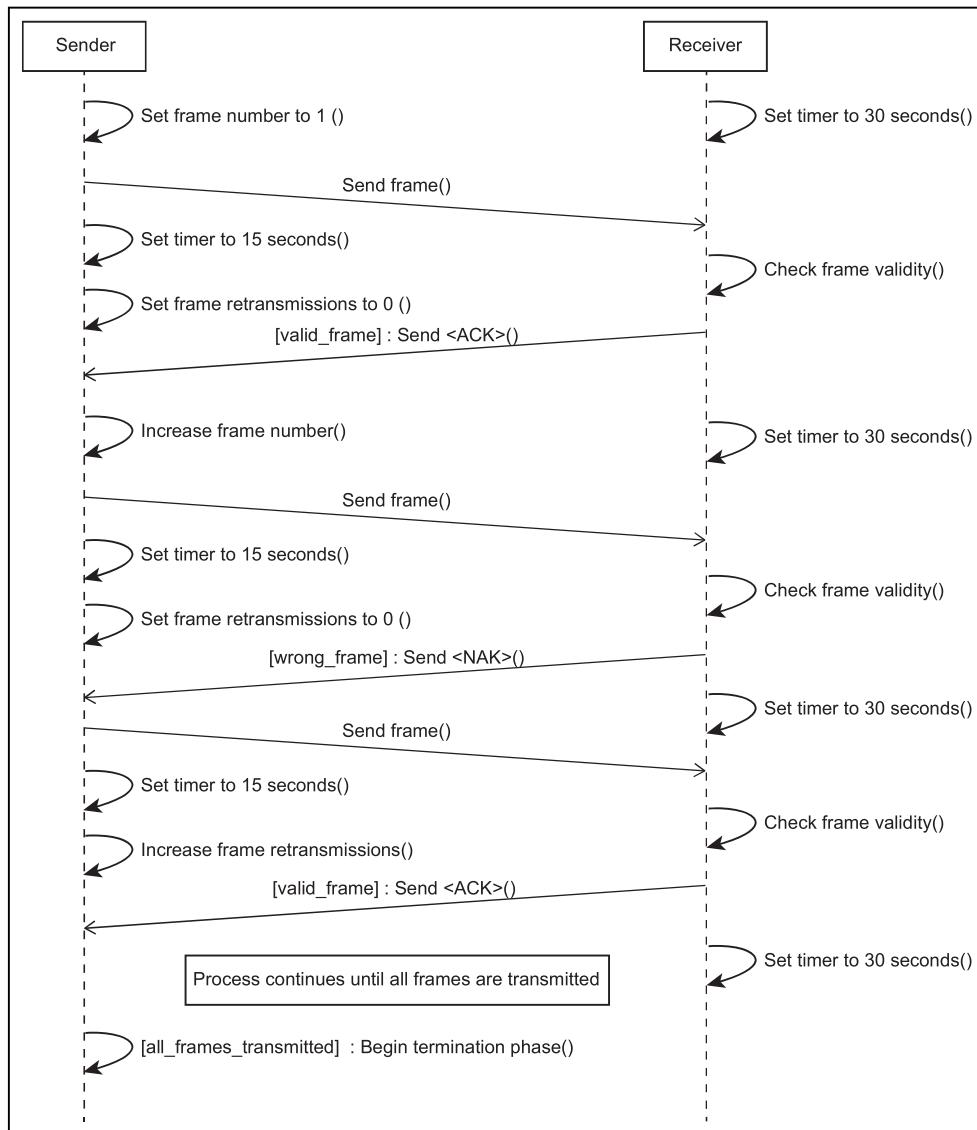
The checksum is computed by adding the binary values of the characters and keeping the least significant eight bits of the result. It is an addition modulo 256 operation.

The <STX> character initializes checksum to zero. The checksum computation uses the frame number, all characters belonging to text, and <ETB> or <ETX>. The computation for the checksum does not include <STX>, the checksum characters, or the trailing <CR> and <LF>.

The checksum is an integer of eight bits, comprised of two groups of four bits. Both groups of four bits are converted to the ASCII characters of the hexadecimal representation, and are transmitted as the message checksum.

Example:

A checksum of 89 can be represented as 01011011 in binary or 5B in hexadecimal. The checksum is transmitted as the ASCII character 5 followed by the ASCII character B.

Figure 24-7 Checksum

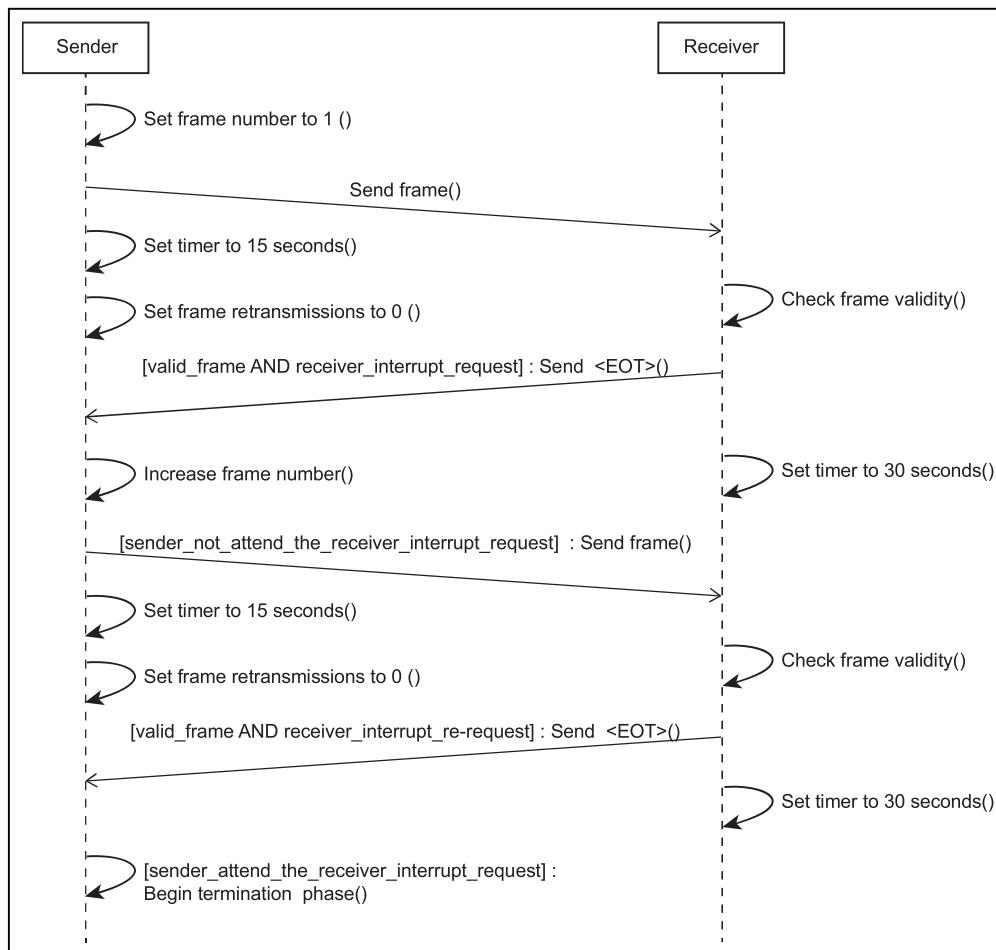
Acknowledgments

After a frame is sent, the sender stops transmitting until a reply is received (stop-and-wait protocol). The receiver can reply to each frame using one of the following methods.

- A reply of <ACK> means the last frame was successfully received and the receiver is ready to receive the next one. The sender must send a new frame or terminate.
- A reply of <NAK> signifies the last frame was not successfully received and the receiver is prepared to receive the frame again.
- A reply of <EOT> means the last frame was successfully received and the receiver is ready to receive the next one.

In addition, <EOT> is a request to the sender to stop transmitting. The instrument sends an <EOT> only when it wants to send a message with high priority. The instrument dismisses <EOT> until the message is finished. Once the message is finished, the instrument allows the other system to retrieve the message.

Figure 24-8 Acknowledgments



Receiver Interrupts

The receiver can request that the sender stop transmitting messages by sending an <EOT> in place of the usual <ACK>. The sender does not have to stop transmitting after receiving the <EOT>.

If the sender ignores the <EOT>, the receiver must re-request the interrupt for the request to remain valid.

If the receiver does not honor the <EOT>, it must first enter the termination phase to return the data link to the neutral state. The original sender must not enter the establishment phase for at least 15 seconds or until the receiver has sent a message and returned the data link to the neutral state.

The instrument ignores the <EOT> until message transmission is complete. If the instrument receives an <EOT> as an answer to the last frame, it waits 15 seconds until it goes to the establishment phase.

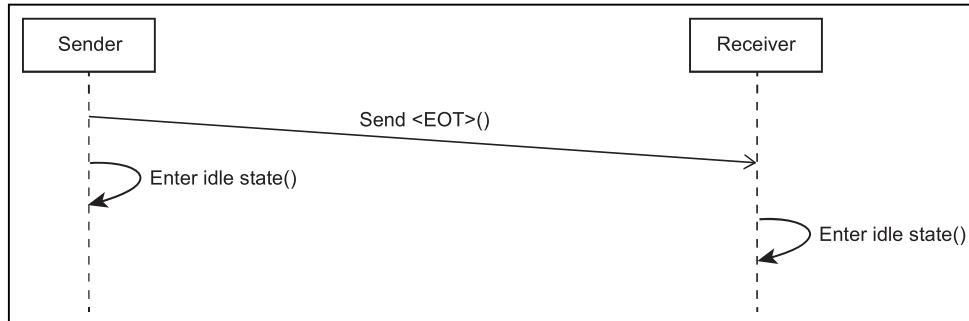
Termination Phase – Link Release

The termination phase returns the data link to the neutral state.

Operation

The sender sends an <EOT> to notify the receiver that all messages have been sent, and then sets up the data link to be in a neutral state.

Figure 24-9 Termination phase



On receiving an <EOT>, the receiver also considers the line to be in a neutral state.

Error Recovery

The receiver checks every frame to guarantee it is valid. It transmits a reply of <NAK> for invalid frames. Upon receiving the <NAK>, the sender retransmits the last frame with the same frame number.

Frames are rejected under the following circumstances:

- A character error is detected (parity errors, framing error, and so on).
- The frame checksum does not match the checksum computed on the received frame.
- The frame number is not the same as the last accepted frame or one number higher (modulo 8).
- There are invalid characters in the message body. See [Restricted Message Characters](#) on page 684.

When checking for frame validity, the receiver ignores characters that occur before <STX> or <EOT> or after the end of the block characters (<ETB> or <ETX>).

Retransmissions

Every time the sender tries to transmit a particular frame and receives a <NAK> or other character different from <ACK> or <EOT> (a <NAK> condition), a retransmission counter for the given frame increases. If the counter shows a single frame was sent and not accepted six times, the sender must proceed to the termination phase.

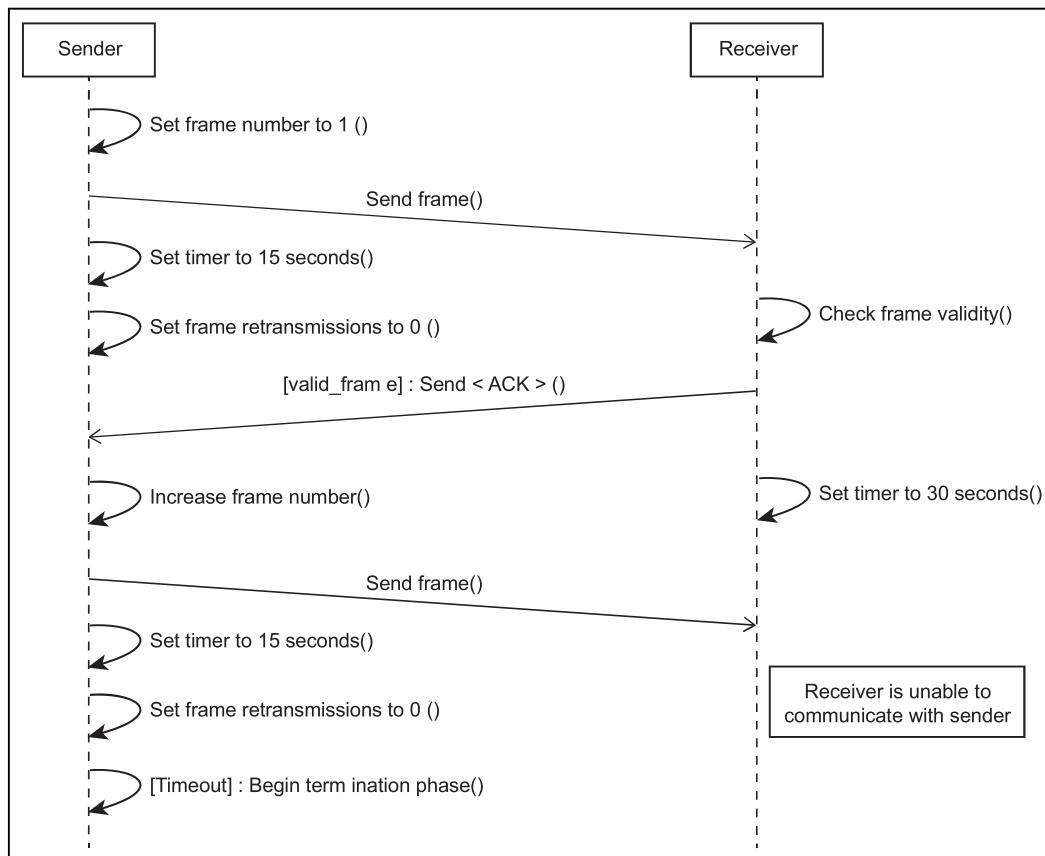
Timeouts

The sender and the receiver use timers to detect loss of coordination between them. The instrument uses the timeout specified for instruments.

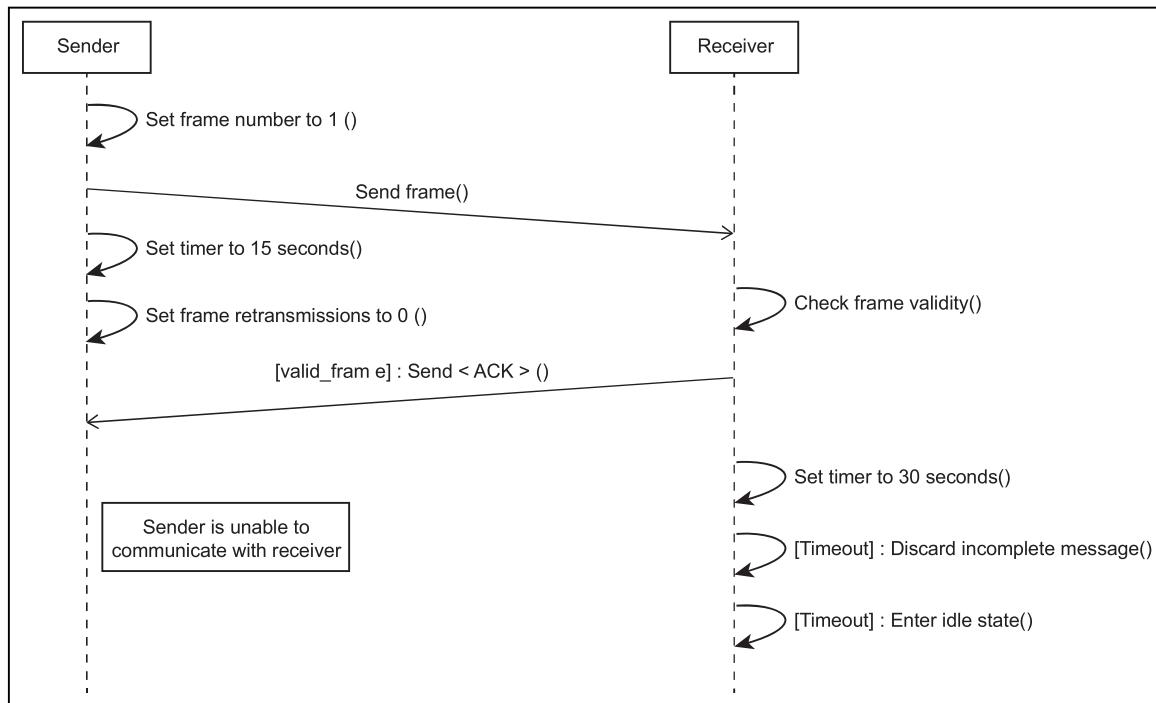
During the establishment phase, the sender sets a timer when transmitting the <ENQ>. A timeout occurs if a reply of an <ACK>, <NAK>, or <ENQ> is not received within 15 seconds. After a timeout, the sender enters the termination phase.

During the transfer phase, the sender sets a timer when transmitting the last character of a frame. If a reply is not received within 15 seconds, a timeout occurs. After a timeout, the sender enters the termination phase.

Figure 24-10 Timeout by senders



The receiver sets a timer when first entering the transfer phase or when replying to a frame. If a frame or an <EOT> is not received within 30 seconds, a timeout occurs. After a timeout, the receiver discards the last incomplete message and regards the line to be in the neutral state.

Figure 24-11 Timeout by receiver

Checking Channel Status

Connection status tells users whether there is a physical connection with the LIS system or if the LIS is rejecting the connection.

When LIS connectivity starts, the instrument sends an <ENQ> until it receives an <ACK>.

- If the instrument receives an <ACK>, it assumes that a connection is established. If no messages are pending to send, the instrument sends an <EOT>.
- If the instrument receives a <NAK>, it assumes that the LIS rejected the connection and it retries every 10 seconds (as specified in the standard) until the connection is accepted.
- If no data is received the application assumes there is no connection with the LIS system. The <ENQ> is sent every 15 seconds (as specified in the standard) until the connection is enabled.

When the connection is accepted, the instrument sends and accepts any messages exchanged with the LIS. If the connection is idle for more than 60 seconds the instrument checks whether the channel is still sending an <ENQ> and, after receiving the response, sends an <EOT> to finish the transmission.

Restricted Message Characters

The data link protocol is designed for sending character-based message text. Some restrictions are placed on the characters that can appear in the message content. [Table 24-68](#) lists the restricted characters.

Table 24-68 Restricted message characters

Transmission control characters	Format effector control character	Device control characters
<SOH>, <STX>, <ETX>, <EOT>, <ENQ>, <ACK>, <DLE>, <NAK>, <SYN>, <ETB>	<LF>	<DC1>, <DC2>, <DC3>, <DC4>

The <LF> character can appear only as the last character of a frame.

Troubleshooting LIS Issues

To troubleshoot LIS connection/configuration problems, you must gather information and provide it to the IT specialist in charge of LIS service. This information includes log files located in **need pathname**, and low level (and application) information available from the Windows Event Viewer.

Table 24-69 lists the logs files in **need pathname**.

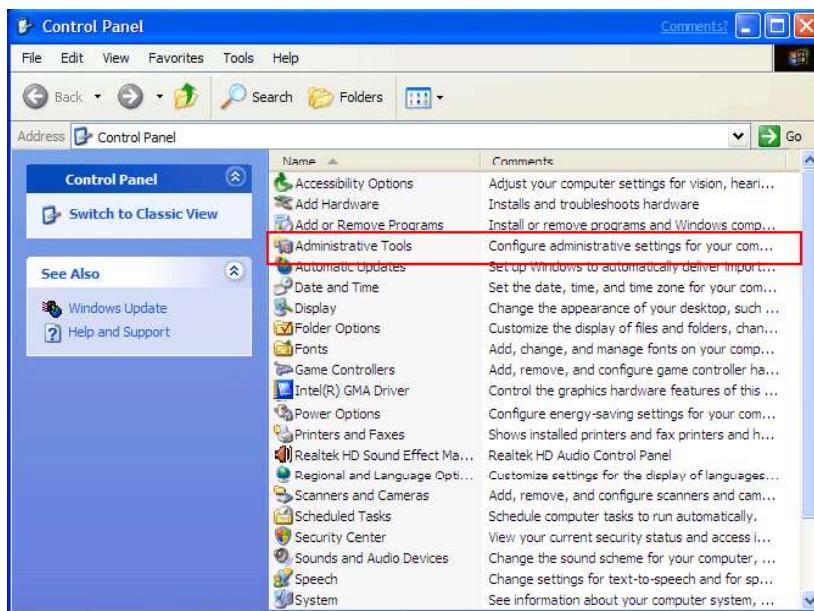
Table 24-69 Instrument log files

Log file	Description
LISmessage.log	A detailed log of all internal XML messages to and from the BIO-FLASH software
NTE_UDC.log	A detailed log of all LIS actions by the UDC module

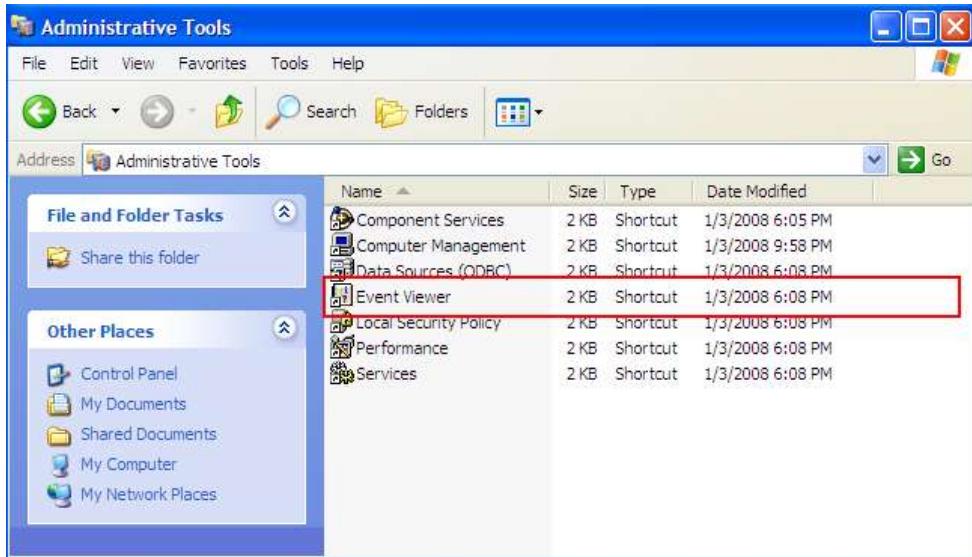
To retrieve information from the Windows Event Viewer:

1. From the Windows Start menu, open the Control Panel, and then double-click **Administrative Tools**.

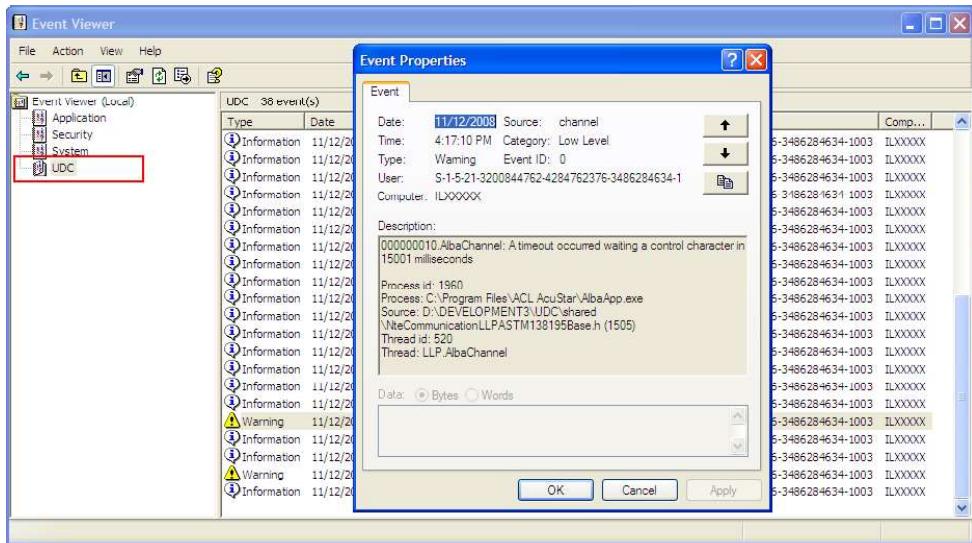
Figure 24-12 Selecting Administrative Tools in the Control Panel



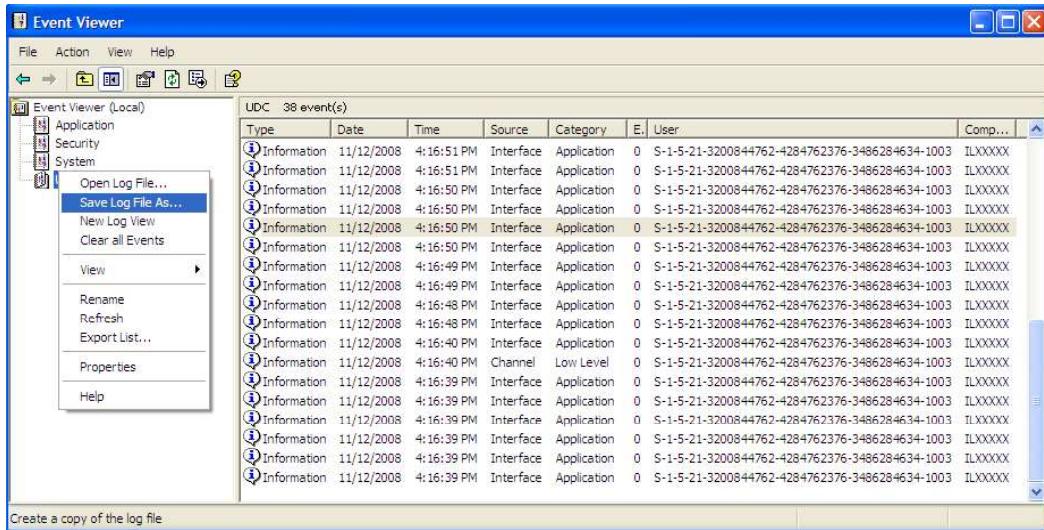
2. In the Administrative Tools folder, select **Event Viewer**.

Figure 24-13 Opening the Event Viewer

3. In the Event Viewer, select the **UDC** branch. Here, you can locate relevant information to troubleshoot LIS configuration/communication problems.

Figure 24-14 Viewing warning properties

4. To save the information as an event (.evt) file, right-click the UDC branch and then select **Save Log File As**.

Figure 24-15 Saving the UDC branch contents as an event log (.evt file)

5. Save the file and provide it and the other instrument log files to the specialist in charge of LIS service.