TSM – Transportation-line System Manager

for

LIS Communication Specifications

Revision 2.1

Nov. 8th, 2002

Document History

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1. Overview

The TSM is a product of HITACHI High-Technologies Corporation.   This section describes the overview of communication protocol between TSM – Transportation-line System Manager and LIS – Laboratory Information System, and describes prerequisites for using its LIS Communication.

1.1. Welcome to TSM

TSM is an acronym for the Transportation-line System Manager.   The TSM from HITACHI High-Technologies Corporation provides an efficient, automated system for performing centrifuging, decapping, sample aliquoting, barcode labeling, transporting to test areas, and loading into analyzers.   TSM automatically performs all of these functions quickly and efficiently through its program modules, while greatly reducing exposure to infectious agents.

1.2. Scope

This document clarifies the communication protocol between TSM and LIS, including test order downloading, sample status uploading and the usage of acknowledgements.   This communication protocol is based on HL-7 – Health Level Seven.   The user of this document should have at least a basic understanding of HL-7 Standard version 2.3 and/or 2.4.   For further information on this implementation of this standard, please refer to:

- Health Level Seven Headquarters
      www.hl7.org

In order to upload pre-process and analysis statuses, the TSM uses NCCLS extension.   This extension enables to transfer aliquot result and sample sorting result to LIS.

1.3. Audience

This sales information is for developers and system engineers who will interface the TSM to LIS.

1.4. Prerequisites

Be sure that the interface driver you develop complies with all of the necessary prerequisites. Please note the following special concerns when using the TSM LIS Communication:

- Do not assume using duplicated sample barcode ID on different primary samples.   For example, the serum sample and urine sample belonging to the same patient should be attached different sample barcode ID.   It may cause the wrong pre-process.
- Do not misplace or swap the sample barcode ID, particularly when placing it on the sample tube. This may cause sample swapping.
- Do not assume using the upper and lower case on barcode ID to differentiate sample if you are using code-128 code B.   For example, TSM does not differentiate sample ID '0001A' and '0001a'.
- Do not use messages that are not described on this document.   They are just implemented to keep backward compatibility with older version of TSM.   Hitachi does not support those messages and they will be discontinued in the near future.

1.5. Abbreviations

Abbreviations	Original Terms	Comments
7600	Name of Clinical Chemistry Modular Analytics in Japan and Asia region	
A/R	Aliquot Results	
ACB	Automatic Centrifuge Buffer	ACB is buffer for ACU
ACL	Automatic Centrifuge Line	
ACU	Automatic Centrifuge Unit	ACB is buffer for ACU
AQN	On-line Aliquoter Module	
AQS	Aliquot Sample Sorter Module	
BCL	Barcode Labeler Module	
C-MA	Clinical Chemistry Modular Analytics	

Abbreviations	Original Terms	Comments
CLAS2	Clinical Laboratory Automation System II	
CLB	Connection Line Buffer	
COL	Column Unit	
CTL	Core Transportation Line	
DSP	Destopper Module	
E-MA	Elecsys Modular Analytics	
H-MA	Hybrid Modular Analytics	
IBM	Input Buffer Module	
MA	Modular Analytics	Common Name of C-, E-, H-Modular
PAM	Pre-analytical Modular System	
OBM	Output Buffer Modular	
RSP	Restopper Module	
SBU	Sample Buffer Unit	Only for CLAS2
SBU-MA	Sample Buffer Unit for Modular Analytics	Only for MPA-PLUS
SSM	Sample Stocker Module	
SSU	Sample Stocker Unit	
SWA	Serum Work Area	
T/R	Test Results	
T/S	Test Selections	
TAT	Turn Around Time	
TL	Transportation Line	
TSM	Transportation-line System Manager	PAM/CLAS2 controller
TUH	Turn Table for Hitachi rack	for 5 position rack, only for CLAS2
TUL	Turntable Line	Only for MPA-PLUS
TUS	Turn Table for Sysmex/Hitachi rack	for 5 and 10 position rack, only for CLAS2
UCL	Universal Connection Line	

2. Hardware and Low-level Protocol

2.1. Communication Hardware

The physical communication hardware is a 10Base-T/100Base-TX Ethernet network interface.
The wiring sequence for 10Base-T/100Base-TX cable ends must conform to AT&T 258A and the twisted-pair wires must be twisted through the entire length of the cable.

2.2. Low Level Protocol

The Low-Level communication protocols used in the implementation are:
- IEEE 802.3
- Transmission Control Protocol / Internet Protocol (TCP/IP) implementation. The Internet Protocol (IP) portion will conform to the IAB/IETF Version 4 (IPv4).
- Minimal Low-Level Protocol as described next section.

2.3. MLLP – Minimal Low-Level Protocol

In order to introduce message orientation to a stream-oriented TCP/IP protocol, a Minimal Low-Level Protocol (MLLP) was proposed. This subchapter contains a very brief overview of MLLP.
HL-7 messages are enclosed by special characters to form a block. The format is as follows:

<SB>dddd<EB><CR>

<SB> = Start Block character (1 byte)
    ASCII <VT>, i.e. <0x0B>. This should not be confused with the ASCII characters SOH or STX.
dddd = Data (variable number of bytes)
    This is the HL7 data content of the block. The data can contain any displayable ASCII characters and the carriage return character, <CR>.
<EB> = End Block character (1 byte)
    ASCII <FS>, i.e. <0x1C>. This should not be confused with the ASCII characters ETX or EOT.
<CR> = Carriage Return (1 byte)
    The ASCII carriage return character, i.e. <0x0D>.

The characters used for beginning and end of the message are configurable at TSM.

2.4. System Interface Diagram

Responsibility

HITACHI← →Customer

Ethernet

Port801

←Test Orders
←Patient Demographics
Sample Status→
Aliquot/Sort Results→
Test Results→

Server   Client

TSM   **LIS**
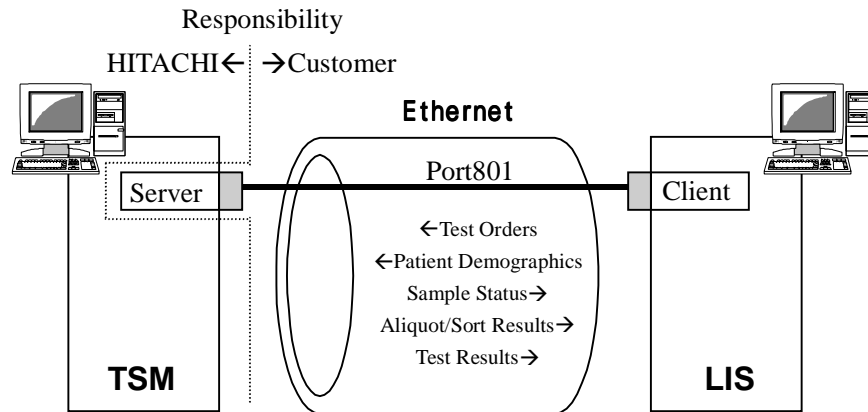
2.5. Responsibility of hardware preparation

HITACHI High-Technologies Corporation prepares Ethernet PC board on the TSM PC.   Customers need to prepare the twisted- pair cables for Ethernet and HUB that interfaces to LIS by when the TSM is installed at the site.

For the more stable communication between TSM and LIS, HITACHI recommends the use of Ethernet cable that:

1)   satisfies Category 5.
2)   is as short as possible.
3)   is shielded twist pair cable[*1]   to cancel electromagnetic noise if necessary.

Notes,
*1: If you use UTP – unshielded twist pair cable and observe unknown communication disconnection that no has relation with TSM and LIS applications, there is a worth to try STP – shielded twist pair cable.   It may solve the disconnection by cancelling electromagnetic noise in your laboratory.

3. Basic Information of HL-7

3.1. Overview

This short chapter describes very briefly major aspects of the HL7 – is an "overview from 20000 feet". Because of the complexity of HL7, an understanding of the specification is only possible by referring to the original standard. For understanding the general principles, reading of the <HL7STD> Chapter 2 is strongly recommended.

3.2. Messages

This section defines the components of messages. A **message** is the atomic unit of data transferred between the systems. It is comprised of a group of segments in a defined sequence.

MESSAGE:
   <SB>SEGMENT 1<CR>
   SEGMENT 2<CR>
   …
   SEGMENT n-1<CR>
   SEGMENT n<EB><CR>

Each message has a **message type** that defines its purpose. A three-character code contained within each message identifies its type. These are listed in the Message Type list, <HL7STD> Appendix A.

The real-world event that initiates an exchange of messages is called a trigger event. (See <HL7STD> Section 2.2.1, "Trigger events," for more detail description of trigger events.) Appendix A of <HL7STD> contains the codes that represent all defined trigger events. These codes represent values such as **An order event occurred**. There is a one-to-many relationship between message types and trigger event codes. The same trigger event code may not be associated with more than one message type; however a message type may be associated with more than one trigger event.

All message types and trigger event codes begin with the letter "**Z**" is reserved for locally defined messages. No such codes will be defined within the HL7 Standard.

A segment is a group of fields. The segment is divided into some fields by delimiters.

A field is a group of components. The field is divided into some components by delimiters.

3.3. Segments

A **segment** is a logical grouping of **data fields**. Segments of a message may be required or optional.

SEGMENT:
   FIELD1|FIELD2|…|FIELDn

They may occur only once in a message or they may be allowed to repeat. Each segment is given a name. For example, the ORU message may contain the following segments: Message Header (MSH), Patient ID (PID), Observation Request (OBR), and one or multiple Observation/Result (OBX).

Each segment is identified by a unique three-character code known as a Segment ID. Although the actual segments are defined in various chapters, the ID codes assigned to all segments are listed in <HL7STD> Appendix A.

All segment ID codes beginning with the letter **Z** are reserved for locally defined messages. No such codes will be defined within the HL7 Standard.

3.4. Fields

A field is a string of characters. HL7 does not care how systems actually store data within an application. When fields are transmitted, they are sent as character strings. Except where noted, HL7 data fields may take on the null value. Sending the null value, which is transmitted as two double quotation marks (""), is different from omitting an optional data field. The difference appears when the contents of a message will be used to update a record in a database rather than create a new one. If no value is sent, (i.e. it is

omitted) the old value should be remained unchanged.   If the null value is sent, the old value should be changed to null.   (For further details, see <HL7STD> Section 2.10, "Message construction rules," - step 2d.)

The various chapters of the Standard contain segment attribute tables.   These tables list and describe the data fields in the segment and characteristics of their usage.   A comprehensive data dictionary of all HL7 fields is provided in <HL7STD> Appendix A.

All fields are case sensitive expect Sample ID field, which is defined for ORC-Placer order number, OBR-Placer order number.

3.5. Delimiters

In constructing a message, certain special characters are used.   They are the segment terminator, the field separator, the component separator, sub-component separator, repetition separator, and escape character. The segment terminator is always a carriage return (in ASCII, a hex 0D).   The other delimiters are defined in the MSH segment, with the field delimiter in the 4th character position, and the other delimiters occurring as in the field called Encoding Characters, which is the first field after the segment ID.   The delimiter values used in the MSH segment are the delimiter values used throughout the entire message. In the absence of the other considerations, HL7 recommends the suggested values found in <HL7STD> *Figure 2-1 delimiter values*.

Delimiter	Suggested Value	Encoding Character Position	Usage
Segment Terminator	<cr> (hex 0d)	-	Terminates a segment record. This value cannot be changed by implementers.
Field Separator	|	-	Separates two adjacent data fields within a segment. It also separates the segment ID from the first data field in each segment.
Component Separator	^	1	Separates adjacent components of data fields where allowed.
Subcomponent Separator	&	4	Separates adjacent subcomponents of data fields where allowed. If there are no subcomponents, this character may be omitted
Repetition Separator	~	2	Separates multiple occurrences of a field where allowed.
Escape Character	¥	3	Escape character for use with any field represented by an ST, TX or FT data type, or for use with the data (fourth) component of the ED data type. If no escape characters are used in a message, this character may be omitted. However, it must be present if subcomponents are used in the message.

3.6. Data Types

HL7 defines many data types. The table below contains only some examples of data types used in this specification.   For more details, please refer to <HL7STD> "chapter *2.8 Data Types*".

Data Type Category/ Data type	Data Type Name	Notes/Format
Alphanumeric		
ST	String	

Numerical		
NM	Numeric	
SI	Sequence ID	
SN	Structured numeric	<comparator> ^ <num1 (NM)> ^ <separator/suffix> ^ <num2 (NM)>
NA	Numeric Array	<value1 (NM)> ^ <value2 (NM)> ^ <value3 (NM)> ^ ...
Identifier		
ID	Coded values for HL7 tables	
IS	Coded value for user-defined tables	
HD	Hierarchic designator	<namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)> Used only as part of EI and other data types.
EI	Entity identifier	<entity identifier (ST)> ^ <namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)>
PT	Processing type	<processing ID (ID)> ^ <processing mode (ID)>
Date/Time		
TS	Time stamp	YYYY[MM[DD[HHMM[SS[.S[S[S[S]]]]]]]][+/-ZZZZ] ^ <degree of precision>
Code Values		
CX	Extended composite ID with check digit	<ID (ST)> ^ <check digit (ST)> ^ <code identifying the check digit scheme employed (ID)> ^ < assigning authority (HD))> ^ <identifier type code (IS)> ^ < assigning facility (HD)
XCN	Extended composite ID number and name	<ID number (ST)> ^ <family name (ST)> ^ <given name (ST)> ^ <middle initial or name (ST)> ^ <suffix (e.g., JR or III) (ST)> ^ <prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (ST)> ^ <source table (IS)> ^ <assigning authority (HD)> ^ <name type code (ID)> ^ <identifier check digit (ST)> ^ <code identifying the check digit scheme employed (ID)> ^ <identifier type code (IS)> ^ <assigning facility (HD)>
Generic		
CM	Composite	
Demographics		
XPN	Extended person name	<family name (ST)> ^ <given name (ST)> ^ <middle initial or name (ST)> ^ <suffix (e.g., JR or III) (ST)> ^ <prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (ST)> ^ <name type code (ID) >
XTN	Extended telecommunications number	[**N**NN] [(999)]999-9999 [X99999] [B99999] [C any text] ^ <telecom-munication use code (ID)> ^ <telecommunication equipment type (ID)> ^ <email address (ST)> ^ <country code (NM)> ^ <area/city code (NM)> ^ <phone number (NM)> ^ <extension (NM)> ^ <any text (ST)>
Time Series:		
TQ	Timing/quantity	<quantity (CQ)> ^ <interval (*)> ^ <duration (*)> ^ <start date/time (TS)> ^ <end date/time (TS)> ^ <priority (ID)> ^ <condition (ST)> ^ <text (TX)> ^ <conjunction (ID)> ^ <order sequencing (*)>

4. Information Flows and Trigger Events

The table below summarizes the trigger events and information flows between TSM and LIS.

Because of currently known performance limitations of various LISs, we tried to avoid the information flows that require a query.   For TSM, event driven information flows are implemented.

The Information Flow ID is introduced for easier referencing in this document. The 1st character means [U]nsolicited or [R]esponse to query. The 2nd character is the flow direction[1], which is either download LIS→TSM [I]ncoming or upload LIS←TSM [O]utgoing. The remaining characters define the primary information: NO – new order, AO – additional order, DO – delete order, PR – previous result, NR – new result (not uploaded before), AR – aliquot result, RR – repeated upload of results (could be repeated/ rerun), XR – any results, SSP – sample status at PAM, SSI – sample status at instrument, PD – profile definition.

#	Flow ID	Information Flow Description	Trigger	Mes-sages	Remarks / references
1.	UI-NO	Unsolicited download of New Order(s)	LIS / User dependent, e.g., "sample sent to lab" or "sample received in lab"	OML	See <HL7STD>.4.2.1/.4.2.6
2.	UI-AO	Unsolicited download of Additional Order(s)	LIS / User dependent, s.a	OML	See <HL7STD>.4.2.1/.4.2.6
3.	UI-DO	Unsolicited Delete of existing Order(s)	LIS / User dependent	OML	<HL7STD>.4.2.1/.4.2.6 delete of the entire Order or selectively by Tests
4.	UO-SSP	Unsolicited Upload of Sample(s) Status at PAM/CLAS2	TSM /PAM identifies Sample(s) or Sample Status at PAM changes significantly	SSU	NCCLS trigger U03 using message SSU <NCCLS>.4.1.5
5.	UO-AR	Unsolicited Upload of Aliquot/Sorting Results	Primary rack leaves the corresponding module	SSU	NCCLS trigger U03 using message SSU <NCCLS>.4.1.5

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[1] The flow direction describes the flow of primary information, i.e. acknowledgments, errors, and queries are not considered as primary information.

5. Message Acknowledgements

5.1. General

This chapter defines specific aspects of the TSM implementation of the Acknowledgments. The HL7 principles are described in <HL7STD>.2.12-13.

Generally: the TSM supports the enhanced processing rules as specified in <HL7STD>.2.12.1. In overview, this exchange proceeds as follows:

Step 1   the initiating system constructs an HL7 message from application data and sends it to the responding system

Step 2   responder receives message and enhanced acknowledgment rules apply

a)   the responding system receives the message and commits it to the safe storage.   This means that the responding system accepts the responsibility for the message in a manner that releases the sending system from any obligation to re-send the message.   The responding system now checks the message header record to determine whether or not the initiating system requires an accept acknowledgment message indicating successful receipt and secure storage of the message.   If it does, the accepted acknowledgment message is constructed and returned to the initiator. [2]

b)   at this point, the requirements of the applications involved in the interface determine whether or not more information needs to be exchanged.   This exchange is referred to as an application acknowledgment and includes information ranging from simple validation to a complex

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2 The detailed process is described in the <HL7STD>.   Generally, the receiver performs the following steps:

    i)   accepts the message

    ii)   makes an initial determination as to whether or not the message can be accepted, based on the factors such as:

        1)   the status of the interface

        2)   the availability of safe storage onto which message can be saved

        3)   the syntactical correctness of the message, if the design of the receiving system includes this type of validation at this phase

        4)   the values of *MSH-9-message type*, *MSH-12-version ID*, and *MSH-11-processing ID*, if the design of the receiving system includes this type of validation at this phase

    iii) examines the Message Header segment (MSH) to determine whether or not the initiating system requires an accept acknowledgment.

       If it does, the responding system returns a general acknowledgment message (ACK) with:

        1)   a commit accept (CA) in *MSA-1-acknowledgment code* if the message can be accepted for processing

        2)   a commit reject (CR) in *MSA-1-acknowledgment code* if the one of the values of *MSH-9-message type*, *MSH-12-version ID* or *MSH-11-processing ID* is not acceptable to the receiving application

        3)   a commit error (CE) in *MSA-1-acknowledgment code* if the message cannot be accepted for any other reason (e.g. sequence number error)

    iv)   If the message header segment indicates that the initiating system also requires an application acknowledgment, this will be returned as the initial message of a later exchange.

application-dependent response. If the receiving system is expected to return application-dependent information, it initiates another exchange when this information is available. This time, the roles of initiator and responder are reversed.

5.2. Incoming Messages

For incoming messages, the TSM supports all types of both "accept acknowledgement" and "application acknowledgment". (see <HL7STD>.2.24.1.15-16) It means that the TSM sends the acknowledgment based on the code in corresponding fields of the Message Header of incoming message.

5.3. Outgoing Messages

It is possible to configure separately what type of "accept acknowledgment" and "application acknowledgment" can be required from the LIS for messages sent by the TSM. This is important to support various LIS implementations. The MSH fields, Seq.No. 00015 and 00016 are set correspondingly to "accept acknowledgement" or "application acknowledgment".

Below is a table listing the support of "accept acknowledgments" and "application acknowledgments" based on message types. It is possible to set the acknowledgment conditions for every specified message types separately. The possible settings are:

NE – never
ER – error/reject conditions only
AL – always
SU – successful completion only.

As a default, TSM sets "ER" in the both the "accept acknowledgment" and the "application acknowledgment". In outgoing message for upload of Test Result (ORU), TSM always sets "AL" in the "Accept Acknowledgment Conditions".

Message Types	Accept Acknowledgment Conditions	Application Acknowledgment Conditions
ACK	NE, **ER** [3]	NE, **ER**
OML	NE, **ER**, AL, SU	NE, **ER**, AL, SU
ORL	NE, **ER**	NE, **ER**
OUL	**AL**	NE, **ER**, AL, SU

5.4. Acknowledgement Message

The simple and general acknowledgment (ACK) can be used where the application does not define a special application level acknowledgment message or where there has been an error that precludes application processing. Even when a special response message is specified by HL7 standard (e.g. ORL – General Response Message), the first part of this message is equal to the ACK message. The ACK is also used for accepting level acknowledgments. The details are described in <HL7STD>.2.12.1.

5.5. Acknowledgement Time-outs

Following acknowledgment related with time-out is configurable within range of 0.01 – 99.99 sec:

• Incomplete message time-out
  Time how long the receiver should wait before it detects a message is incomplete (Referring to MLLP: this is the time-out between receiving <SB> and <EB>)

The TSM does not use Acknowledgment time-out, i.e. TSM as a sender does not wait a specific time for the acknowledgment after sending a message. TSM does not wait for an acknowledgment of previous

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[3] To avoid 'loop' of positive acknowledgments in response to positive acknowledgment AL and SU should not be possible.

message before sending the next message. However, for results transfer, TSM keeps track of and marks results that were not acknowledged by the LIS.

5.6. Accept Acknowledgement

In case that MSH-15 on previous message is AL, an accept acknowledgement message needs to be replied. In case that MSH-15 is ER on previous message and it is included an error, an accept acknowledgement message needs to be replied, too.

5.6.1. Structure

```
MSH                     Message Header
MSA                     Message acknowledgment
[ ERR ]                 Error
```

5.6.2. Example

An example for accepts acknowledgement message is given as below. Refer to "6.2.1.2 Example" to know the entire message flow; i.e. relation with the other message.

```
<SB>
MSH|^~¥&|TSM|HII|LIS|RDC|20010705113432||ACK|111420710011|P|2.3|||NE|NE||8859/
1
MSA|CA|200001010001|Success
<EB>
```

5.6.3. Contents

No.	Field	Description	Len	Level; to TSM	Level; from TSM	Data Type

1	MSH-1	Field Separator
		    Value: ASCII 124 (|)
		    This field contains the separator between the segment ID and the first real field.
			1	R	R	ST

2	MSH-2	Encoding Character
		    Values: ASCII 94, 126, 92, and 38 (^~¥&)
		    This field contains the four characters in the following order: the component separator, repetition separator, escapes character, and subcomponent separator.
			4	R	R	ST

3	MSH-3	Sending Application Fill here name of LIS application	180	O	R	HD
4	MSH-4	Sending Facility Fill here name of Facility where LIS locates.	180	O	R	HD
5	MSH-5	Receiving Application Fills here name of receiving application.	180	O	R	HD
6	MSH-6	Receiving Facility Fills here name of receiving facility.	180	O	R	HD

7	MSH-7	Date / Time of message
		    Fill here System time of LIS.
		    The format is "YYYYMMDDHHMMSS".
		    LIS should fill LIS's system time.
			14	O	R	TS

8	MSH-9	Message Type Value: ACK	7	R	R	CM

No.	Field	Description	Len	Level; to TSM	Level; from TSM	Data Type
		Refer to this field to know what this message is.				
9	MSH-10	Message Control ID This field contains a number or other identifier that uniquely identifies the message. The receiving system echoes this ID back to the sending system in the Message acknowledgment segment (MSA).	20	R	R	ST
10	MSH-11	Processing ID Value: P This two-component field, "Processing ID" and "Processing Mode", indicates how to process this message.	3	R	R	PT
11	MSH-12	Version ID Value: 2.3 This field is matched by the receiving system to its own version to be sure the message will be interpreted correctly.	8	O	R	ID
12	MSH-15	Accept Acknowledgment Type Value: NE. This field indicates the conditions under which accept acknowledgement is required to be returned in response to this message.	2	R	R	ID
13	MSH-16	Application Acknowledgment Type Value: NE. This field indicates the conditions under which application acknowledgement is required to be returned in response to this message.	2	R	R	ID
14	MSH-18	Character Set Value: 8859/1 The TSM supports only the character set 8859/1, which is the ISO descriptor for "Latin-1". The default character set ASCII (7-bit) is compatible with all other 8-bit character sets.	6	R	R	ID
15	MSA-1	Acknowledgement Code This field contains an acknowledgment code. The valid entries are: CA: Accept acknowledgment, Commit Accept CE: Accept acknowledgment, Commit Error CR: Accept acknowledgment, Commit Reject	2	R	R	ID
16	MSA-2	Message Control ID Fill the same value with MSH-10 of previous message to this field.	20	R	R	ST
17	MSA-3	Text Message This field in the incoming negative (erroneous) acknowledgment should be used in error logs or presented to an end user. In the outgoing negative acknowledgment, the Text Message field is filled by the TSM with relevant error message.	80	R	R	ST

5.7. Application Acknowledgement

In case that MSH-16 on OML message is AL, an accept acknowledgement message needs to be replied. In case that MSH-16 is ER on OML message and the message included an error, an application acknowledgement message needs to be replied, too.

5.7.1. Structure

```
MSH          Message Header
MSA          Message acknowledgment
PID          Patient Identification
{
SAC          Specimen Container Detail
  ORC        Common Order
}
```

5.7.2. Example

Examples for application acknowledgement message are given below.   Refer to "6.2.1.2 Example" to know the entire message flow; i.e. relation with the other message.

1) Example for abnormal condition; not registered application code A51 was downloaded from LIS
; OUL
```
MSH|^~¥&|LIS1|RDC|TSM|HII|||OML^O21|00000000007|P||||AL|AL||8859/1
PID|||Patien17||Last01234567890123456789^Given012345678901234567890^Middle^Sf0
123^Pf0123^Dg0123||199001010101|F
ZPD|19990101|FOL
SAC|||Sample17
ORC|XO|^^12345|||||^^^^^R^EVER|||||Dr.Simmons/Buld#A
OBR|1|||A11|||199812241000||||A|01|||SERPLAS|||S.Comment1|S.Comment2
OBR|1|||A51|||199812241000||||A|01|||SERPLAS|||S.Comment1|S.Comment2
<EB>

<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20010724183921||ACK|365213940008|P|2.3|||NE|NE||8
859/1
MSA|CA|00000000007|Success
<EB>

<SB>MSH|^~¥&|LIS|RDC|TSM|HII|20010724183921||ORL^O22|365215750009|P|2.4|||NE|N
E||8859/1
MSA|AA|00000000007|One or more test code like A51 is not mapped in TSM
PID|||Patien17||Last012345678901234^Given01234^M^Sf0^Pf0^Dg01^L||1990010101010
0|F
SAC|||Sample17
ORC|XR|^^12345|||HD||^^^^^R|||||Dr.Simmons/Buld#A
<EB>
```

2) Example for normal condition
; Application acknowledgement
```
<SB>
MSH|^~¥&|TSM|HII|LIS|RDC|20010705113432||ORL^O22|111423710012|P|2.4|||NE|NE||8
859/1
MSA|AA|200001010001|Success
PID|||Patient2||Family^Given^M^Sf^Pf^Dg^L||19900101010100|F
SAC|||200107050001
ORC|XR|^^0|||HD||^^^^^R|||||Dr.Simmons/Buld#A
<EB>
```

5.7.3. Contents

No.	Field	Description	Len	Level; from TSM	Data Type
1	MSH-1	Field Separator Value: ASCII 124 (|) This field contains the separator between the segment ID and the first real field.	1	R	ST
2	MSH-2	Encoding Character Values: ASCII 94, 126, 92, and 38 (^~¥&) This field contains the four characters in the following order: the component separator, repetition separator, escape character, and subcomponent separator.	4	R	ST
3	MSH-3	Sending Application TSM fills name of itself as defined on Config/Host Communication Configuration.	180	R	HD
4	MSH-4	Sending Facility TSM fills facility name of itself as defined on Config/Host Communication Configuration.	180	R	HD
5	MSH-5	Receiving Application TSM fill fills name of LIS application as defined on Config/Host Communication Configuration.	180	R	HD
6	MSH-6	Receiving Facility TSM fills name of LIS facility as defined on Config/Host Communication Configuration.	180	R	HD
7	MSH-7	Date / Time of message TSM fill its system time. The format is YYYYMMDDHHMMSS.	14	R	TS
8	MSH-9	Message Type Values: ORL^O22 Refer to this field to know what this message is.	7	R	CM
9	MSH-10	Message Control ID This field contains a number or other identifier that uniquely identifies the message. The receiving system echoes this ID back to the sending system in the Message acknowledgment segment (MSA).	20	R	ST
10	MSH-11	Processing ID Values: P This two-component field, "Processing ID" and "Processing Mode", indicates how to process this message.	3	R	PT
11	MSH-12	Version ID Values: 2.4 This field is matched by the receiving system to its own version to be sure the message will be interpreted correctly.	8	R	ID
12	MSH-15	Accept Acknowledgment Type Value: NE, or ER to keep track later. This field indicates the conditions under which accept acknowledgement is required to be returned in response to this message.	2	R	ID

No.	Field	Description	Len	Level; from TSM	Data Type
13	MSH-16	Application Acknowledgment Type Value: NE, or ER to keep track later. This field indicates the conditions under which application acknowledgement is required to be returned in response to this message.	2	R	ID
14	MSH-18	Character Set Values: 8859/1 The TSM supports only the character set 8859/1, which is the ISO descriptor for "Latin-1". The default character set ASCII (7-bit) is compatible with all other 8-bit character sets.	6	R	ID
15	MSA-1	Acknowledgement Code This field contains an acknowledgment code. The valid entries are: AA: Application acknowledgment, Accept AE: Application acknowledgment, Error AR: Application acknowledgment, Reject	2	R	ID
16	MSA-2	Message Control ID Fill the same value with MSH-10 of previous message to this field.	20	R	ST
17	MSA-3	Text Message This field in the incoming negative (erroneous) acknowledgment should be used in error logs or presented to an end user. In the outgoing negative acknowledgment, the Text Message field is filled by the TSM with relevant error message.	80	R	ST
18	PID-3	Patient ID (Internal ID) This field contains the primary identifier, or other identifiers used by the facility to identify a patient uniquely (e.g., medical record number, billing number, birth registry, etc.). This ID is assigned patient by patient, not assigned sample container by sample container. TSM does not accept repetition of this field, i.e. the first occurrence is evaluated and the repetitions are ignored. This field can be printed on barcode label attached on aliquot sample tube by BCL.	20	R	ST
19	PID-5	Patient Name Components: <family name (ST)> ^ <given name (ST)> ^ <middle initial (ST)> ^ <suffix (e.g., JR or III) (ST)> ^ <prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (ST)> ^ <name type code (ID) > This field contains the legal name of the patient. TSM does not accept repetition of this field, i.e. the first occurrence is evaluated and the repetitions are ignored. This field can be printed on barcode label attached on aliquot sample tube by BCL. - Family name: 19 characters	42	R	XPN

No.	Field	Description	Len	Level; from TSM	Data Type
		- Given name: 10 characters - Middle name initial: 1 character - Suffix: 3 characters - Prefix: 3 characters - Degree: 4 characters			
20	PID-7	Date/Time of Birth This field contains the patient's date and time of birth. (Format: YYYYMMDD[HHMM[SS]].) Patient's age is calculated by this field and ObservationDate/Time. Then, it is used to determine target range for range check.	14	R	TS
21	PID-8	Sex This field contains the patient's sex. F: female M: male U: unknown O: other All the codes above except M, F, and O are converted to U: Unknown. Range check uses this field to differentiate its boundary.	1	R	IS
22	SAC-3	Container Identifier Fill here Sample ID printed on barcode label attached on primary sample. This will be the key to handle sample on Pre-analytical Modular system and clinical chemistry analyzer 7600 by TSM. TSM handles up to 16 characters itself. But, if you control PAM and 7600 from TSM, 13 characters are the maximum length.	13 (16)	R	ST
23	ORC-1	Order Control Determines the function of the order segment. OK: Order accepted & OK UA: Unable to accept order CR: Cancelled as requested UC: Unable to cancel UX: Unable to change XR: Changed as requested	2	R	ID
24	ORC-2	Placer Order Number Components: `<entity identifier (ST)> ^ <namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)>` This field is the placer application's order number 3rd component <universal ID> is used for Collection Number up to 5 numeric characters. It is mainly for Japanese market.	5	R	ID
25	ORC-5	Order Status This field is the status of an order. The purpose of this field is to report the status of an order either upon request (solicited), or when the status changes	2	R	ID

No.	Field	Description	Len	Level; from TSM	Data Type
		(unsolicited). Value: HD HD means that Order on hold (sample not yet seen by TSM – not recognized by PAM or instrument)			
26	ORC-7	Quantity/Timing `Components: <quantity (CQ)> ^ <interval (CM)> ^ <duration (ST)> ^ <start date/time (TS)> ^ <end date/time (TS)> ^ <priority (ST)> ^ <condition (ST)> ^ <text (TX)> ^ <conjunction (ST)> ^ <order sequencing (CM)>` This field contains information about how many services to perform at one service time and how often the service times are repeated, and to fix duration of the request. The 6ᵗʰ component <Priority> is to define the pre-process priority. Available values are: S: STAT R: Routine	1	R	TQ
27	ORC-12	Ordering Provider This field is used for Physician. TSM will take up to 20 characters. Even if LIS downloads it with OBR-16, TSM will ignore it.	20	R	ST

6. Messages Specifications

6.1. General

Messages and their associated segments are defined below with versions valid for various information flows. Here defined messages represent a subset of the original messages. It means that others as specified segments of incoming message will be ignored by the TSM.

Each message is defined in a special notation that lists the segment IDs in the order they would appear in the message. Braces, { ... }, indicate one or more repetitions of the enclosed group of segments. (Of course, the group may contain only a single segment.) Brackets, [...], show that the enclosed group of segments is optional. If a group of segments is optional and may repeat, it should be enclosed in brackets and braces, { [...] }.

6.2. Unsolicited Download of New Orders; UI-NO / Additional Order; UI-AO

6.2.1. OML – Laboratory Order Message; HL7 ver.2.4

For various information flows various combinations of segments are relevant. This chapter describes the information flow dependent versions of the OML.

6.2.1.1. Structure

```
MSH                                    Message Header
PID                                    Patient Identification
    [ZPD]                              Patient Code Details
{
SAC                                    Specimen Container Detail
{
  ORC                                  Common Order
    OBR                                Observation Request
      [TCD]                            Test Code Details
      [{NTE}]                          Notes and Comments (for Detail)
  }
}
```

6.2.1.2. Example

The following trace is to order:
1) Sample ID: 200107050001
2) Order New Tests whose LIS codes are A11, A12, B11, B12, B21, B31, B41

```
# LIS → TSM; OML message example
<SB>
MSH|^~¥&|LIS|RDC|TSM|HII|||OML^O21|200001010001|P|2.4|||AL|AL||8859/1
PID|||Patient2||Family^Given^M^Sf^Pf^Dg||199001010101|F
ZPD|19990101|FOL        # This line can be skipped if Expected date of birth
                        # and Menstruation cycle are not needed.
SAC|||200107050001
ORC|XO|||||||^^^^^R^EVER||200001011000|||Dr.Simmons/Buld#A
OBR|1|||A11|||199812241000|||A|01|||SERPLAS|||S.Comment1|S.Comment2
TCD|A11|1        ## This line can be skipped if auto dilution code is normal (default).
OBR|2|||A12|||199812241000|||A|01|||SERPLAS|||S.Comment1|S.Comment2
TCD|A12|2        ## This line can be skipped if auto dilution code is normal (default).
OBR|3|||B11|||199812241000|||A|01|||SERPLAS|||S.Comment1|S.Comment2
OBR|4|||B12|||199812241000|||A|01|||SERPLAS|||S.Comment1|S.Comment2
```

```
OBR|5|||B21|||199812241000||||A|01|||SERPLAS|||S.Comment1|S.Comment2
OBR|6|||B31|||199812241000||||A|01|||SERPLAS|||S.Comment1|S.Comment2
OBR|7|||B41|||199812241000||||A|01|||SERPLAS|||S.Comment1|S.Comment2
<EB>
```

 # TSM → LIS; you get this accept acknowledgement message if you fill 'AL' in MSH-15 on OML message.
```
<SB>
MSH|^~¥&|TSM|HII|LIS|RDC|20010705113432||ACK|111420710011|P|2.3|||NE|NE||8859/
1
MSA|CA|200001010001|Success
<EB>
```

 # TSM → LIS; you get this application acknowledgement message if you fill 'AL' in MSH-16 on OML message.
```
<SB>
MSH|^~¥&|TSM|HII|LIS|RDC|20010705113432||ORL^O22|111423710012|P|2.4|||NE|NE||8
859/1
MSA|AA|200001010001|Success
PID|||Patient2||Family^Given^M^Sf^Pf^Dg^L||19900101010100|F
SAC|||200107050001
ORC|XR|^^0|||HD||^^^^^R|||||Dr.Simmons/Buld#A
<EB>
```

6.2.1.3. Contents

No.	Field	Description	Len	Level	Data Type
1	MSH-1	Field Separator Value: ASCII 124 (|) This field contains the separator between the segment ID and the first real field.	1	R	ST
2	MSH-2	Encoding Character Values: ASCII 94, 126, 92, and 38 (^~¥&) This field contains the four characters in the following order: the component separator, repetition separator, escape character, and subcomponent separator.	4	R	ST
3	MSH-3	Sending Application Fill here name of LIS application	180	O	HD
4	MSH-4	Sending Facility Fill here name of facility where LIS locates	180	O	HD
5	MSH-5	Receiving Application Fills here name of receiving application	180	O	HD
6	MSH-6	Receiving Facility Fills here name of receiving facility	180	O	HD
7	MSH-7	Date / Time of message Fill here System time of LIS. The format is YYYYMMDDHHMMSS. LIS should fill LIS's system time.	14	O	TS
8	MSH-9	Message Type Value: OML^O21 Refer to this field to know what this message is.	7	R	CM
9	MSH-10	Message Control ID This field contains a number or other identifier that uniquely identifies the message. The receiving system	20	R	ST

No.	Field	Description	Len	Level	Data Type
		echoes this ID back to the sending system in the Message acknowledgment segment (MSA).			
10	MSH-11	Processing ID Values: P This two-component field, "Processing ID" and "Processing Mode", indicates how to process this message.	3	R	PT
11	MSH-12	Version ID Values: 2.4 This field is matched by the receiving system to its own version to be sure the message will be interpreted correctly.	8	R	ID
12	MSH-15	Accept Acknowledgment Type Value: 'AL' This field indicates the conditions under which accept acknowledgement is required to be returned in response to this message.	2	R	ID
13	MSH-16	Application Acknowledgment Type Value: 'AL' This field indicates the conditions under which application acknowledgement is required to be returned in response to this message.	2	R	ID
14	MSH-18	Character Set Values: 8859/1 The TSM supports only the character set 8859/1, which is the ISO descriptor for "Latin-1". The default character set ASCII (7-bit) is compatible with all other 8-bit character sets.	6	R	ID
15	PID-3	Patient ID (Internal ID) This field contains the primary identifier, or other identifiers used by the facility to identify a patient uniquely (e.g. medical record number, billing number, birth registry, etc.). This ID is assigned patient by patient, not assigned sample container by sample container. TSM does not accept repetition of this field, i.e. the first occurrence is evaluated and the repetitions are ignored. This field can be printed on barcode label attached on the aliquot sample tube by BCL.	20	O	ST
16	PID-5	Patient Name `Components: <family name (ST)> ^ <given name (ST)> ^ <middle initial (ST)> ^ <suffix (e.g., JR or III) (ST)> ^ <prefix (e.g., DR) (ST)> ^ <degree (e.g., MD) (ST)> ^ <name type code (ID) >` This field contains the legal name of the patient. TSM does not accept repetition of this field, i.e. the first occurrence is evaluated and the repetitions are ignored. This field can be printed on barcode label attached on aliquot sample tube by BCL. - Family name: 19 characters	42	O	XPN

No.	Field	Description	Len	Level	Data Type
		- Given name: 10 characters - Middle name initial: 1 character - Suffix: 3 characters - Prefix: 3 characters - Degree: 4 characters			
17	PID-7	Date/Time of Birth This field contains the patient's date and time of birth. (Format: YYYYMMDD[HHMM[SS]].) Patient's age is calculated by this field and ObservationDate/Time. Then, it is used to determine target range for range check.	14	O	TS
18	PID-8	Sex This field contains the patient's sex. F: female M: male U: unknown O: other All except 'M', 'F', and 'O' are converted to "Unknown". Range check uses this field to differentiate its boundary.	1	O	IS
19	ZPD-1	Expected Date of Birth This field is used for calculation of the gestational age (length of the time since conception) in days of a pregnancy. This information is required for test orders (e.g. some hormones), of which result depends on gestational age. (Format: YYYYMMDD.) To calculate the Gestational age, subtract Collection Date from Expected Date of Birth (EDOB) getting the number of days remaining prior to EDOB. This number should be subtracted from the full gestational period (for humans this is 280 = 40 weeks x 7 days)) to give the number of elapsed gestation days. Thus, the formula for humans would be: `Gestational age (in days) = 280 - (EDOB - Collection Date)`	8	O	DT
20	ZPD-2	Menstruation Cycle/Post-Menopause This field identifies the menstruation cycle that the individual is at the time of collection. This information is required for some test orders (e.g. hormones). Following codes may be used: PRE: Pre-Menstrual FOL: Follicular OVU: Ovulatory LUT: Luteal POST: Post-Menopausal	4	O	ID
21	SAC-3	Container Identifier Fill here Sample ID printed on barcode label attached on primary sample. This will be the key to handle sample on Pre-analytical Modular system and clinical chemistry analyzer 7600 by TSM. TSM handles up to 16 characters itself. But, if you	13 (16)	R	ST

No.	Field	Description	Len	Level	Data Type
		control PAM and 7600 from TSM, 13 characters are the maximum length.			
22	ORC-1	Order Control Value: XO Determines the function of the order segment. XO means 'Change Order'.	2	R	ID
23	ORC-2	Placer Order Number `Components: <entity identifier (ST)> ^ <namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)>` 3rd component <universal ID> is used for Collection Number up to 5 numeric characters. It is mainly for Japanese market.	5	R	ID
24	ORC-7	Quantity/Timing `Components: <quantity (CQ)> ^ <interval (CM)> ^ <duration (ST)> ^ <start date/time (TS)> ^ <end date/time (TS)> ^ <priority (ST)> ^ <condition (ST)> ^ <text (TX)> ^ <conjunction (ST)> ^ <order sequencing (CM)>` This field contains information about how many services to perform at one service time and how often the service times are repeated, and to fix duration of the request. The 6th component <Priority> is to define the pre-process priority. Samples assigned STAT priority: - have shorter timeout than routine priority sample to wait next run at centrifuge buffer. The STAT and Routine timeouts can be defined at Configuration/Centrifuge by Supervisor users. - skip buffer modules on transportation line to pass routine samples. Available values are: S: STAT (1st highest priority) A: ASAP (2nd highest priority)→Converted to S in TSM R: Routine (default) P: Preop→Converted to R in TSM C: Callback→Converted to R in TSM The 7th component <Condition> is to switch on/off reflex function. TSM creates reflex order according to data validation result. Available values are: EVER: Enable reflex order if any reflex orders are created. This is default setting. NEVER: Disable reflex always.	6	O	TQ
25	ORC-9	Date/Time of Transaction TSM uses this field as Order Date / Time. The format is: YYYYMMDDHHMM If LIS does not fill this field, TSM automatically uses transaction Date / Time as Order Date / Time.	12	O	TS

No.	Field	Description	Len	Level	Data Type
26	ORC-12	Ordering Provider This field is used for Physician. TSM will take up to 20 characters. Even if LIS downloads it with OBR-16, TSM will ignore it.	20	O	ST
27	OBR-1	Set ID – OBR For the first order transmitted, the sequence number will be 1; for the second order, it will be 2; …	4	O	SI
28	OBR-4	Universal Service ID `Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)>` Fill an application code to 1st component of this field. - Identifier: application code up to 20 alphanumeric characters.	20	R	CE
29	OBR-7	Observation Date/Time This field is used for collection Date/Time. TSM picks first observation Date/Time in OBR as collection Date/Time of the sample.	14	O	TS
30	OBR-11	Specimen Action Code Value: A The meaning is "add ordered tests to the existing specimen". This field is the action to be taken with respect to the specimens that accompany or precede this order. The purpose of this field is to further qualify (when appropriate) the general action indicated by the order control code contained in the accompanying ORC segment.	1	R	ID
31	OBR-12	Danger Code This field is the code and/or text indicating any known or suspected patient or specimen hazards TSM will store this field to Danger field in DB. The Danger Code send from LIS, needs to be same as internal code used for TSM. These available danger codes are defined at Configuration/Dictionary as TSM parameter.	2	O	ST
32	OBR-15	Specimen Source The TSM will parse the specimen type from this field. Available values for specimen types are defined at Configuration/Specimen at TSM. Maximum number of specimen types to be defined at the TSM is: 20.	16	R	CM
33	OBR-18	Placer Field 1 `Components: <Comment1(ST)> ^ <Comment2(ST)> ^ <Comment3(ST)> ^ <Comment4(ST)> ^ <Comment5(ST)>` These are specific fields filled by the LIS. Some LIS installations use these fields for transferring information such as target instrument, tray/cup, accession area/number/date, bar-code comments, etc.	50	O	ST
34	OBR-19	Placer Field 2	50	O	ST

No.	Field	Description	Len	Level	Data Type
		`Components: <Comment1(ST)> ^ <Comment2(ST)> ^ <Comment3(ST)> ^ <Comment4(ST)> ^ <Comment5(ST)>` These are specific fields filled by the LIS. Some LIS installations use these fields for transferring information such as target instrument, tray/cup, accession area/number/date, bar-code comments, etc.			
35	TCD-1	Universal Service Identifier `Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)>` This field identifies the test code that information is being transferred about. The 1st component of this field identifies the test code that information is being transmitted about. Simply fill here same value with last OBR-4. If you need to specify Auto dilution factor for a test, you need to fill this field.	20	O	CE
36	TCD-2	Auto-Dilution Factor This field is the value that is to be used as the factor for automatic dilution for a particular specimen by an instrument for this particular test code. Following codes are supported in the TSM. 1: Normal: Default 2: Increase1 3: Decrease1 4: Increase2 5: Decrease2	3	O	NM

6.3. Unsolicited Delete of existing Order(s)

6.3.1. OML – Laboratory Order Message; HL7 ver.2.4

6.3.1.1. Structure
Same as "6.2.1.1 Structure".

6.3.1.2. Example
The following trace is to order:
1) Sample ID: 200107050001
2) Delete a test whose LIS code is B41

 # LIS → TSM
```
<SB>
MSH|^~¥&|LIS|RDC|TSM|HII|||OML^O21|200001010001|P|2.4|||AL|AL||8859/1
PID|0001||Patient2||Family^Given^Middle^Sf^Pf^Dg||199001010101|F
ZPD|19990101|FOL
SAC|||200107050001
ORC|XO|||||||^^^^^R^EVER||200001011000|||Dr.Simmons/Buld#A
OBR|1|||B41|||199812241000||||R|01|||SERPLAS|||S.Comment1|S.Comment2
                        # ^-- OBR-11 is R instead of A
```

```
<EB>
```

 # TSM → LIS
```
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20010705130847||ACK|167978340029|P|2.3|||NE|NE||8
859/1
MSA|CA|200001010001|Success
<EB>
```

 # TSM → LIS
```
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20010705130848||ORL^O22|167980140030|P|2.4|||NE|N
E||8859/1
MSA|AA|200001010001|Success
PID|||Patient2||Family^Given^M^Sf^Pf^Dg^L||19900101010100|F
SAC|||200107050001
ORC|XR|^^0|||HD||^^^^^R|||||Dr.Simmons/Buld#A
<EB>
```

6.3.1.3. Contents
Refer to "6.2.1.3 Contents" except fields in matrix shown below.

No.	Field	Description	Len	Level	Data Type
1	OBR-11	Specimen Action Code Value: R The meaning is 'LIS deletes a test order' This field is the action to be taken with respect to the specimens that accompany or precede this order. The purpose of this field is to further qualify (when appropriate) the general action indicated by the order control code contained in the accompanying ORC segment.	1	R	ID

6.4. Unsolicited Upload of Sample Status at PAM
In order to enable these sample status upload, check 'Support NCCLS Protocol' on Host Communication Configuration/ Configuration.
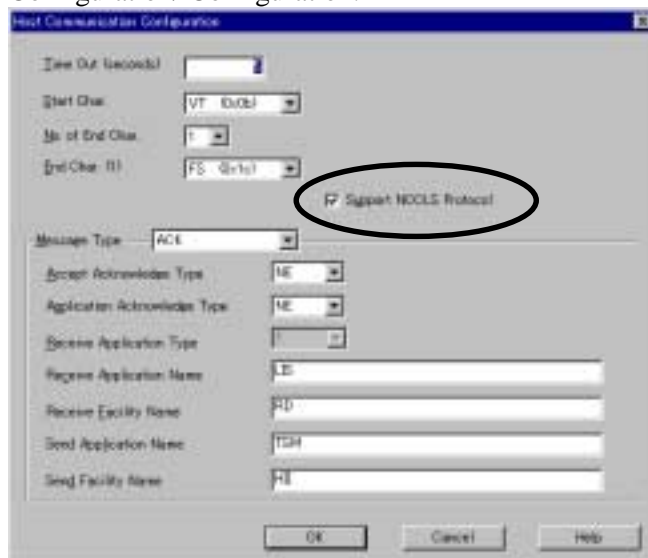
6.4.1. Sample Arrival at Sample Setting Port; UI-SSP

This message is uploaded from TSM to LIS when IBM of PAM or UCL of CLAS2 reads barcode ID attached on the primary sample.   LIS may use this message as a receipt of arrival of the sample.

6.4.1.1. Structure

```
MSH           Message Header
EQU           Equipment Detail
{ SAC }       Specimen and Container Detail
```

6.4.1.2. Example

TSM → LIS

```
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20000315184606||SSU^U03|30401531|P|2.3|||NE|NE||8
859/1
EQU|^^^IBM^Input Buffer^Hitachi|20000315184606
SAC|||9804011234005||||20000315184606|I^^^A^^Hitachi|HIT5|6102|1

MSH|^~¥&|TSM|HII|LIS|RDC|20000315184606||SSU^U03|30401531|P|2.3|||NE|NE||8859/
1
EQU|^^^IBM^Input Buffer^Hitachi|20000315184606
SAC|||9804011234130||||20000315184606|I^^^A^^Hitachi|HIT5|6102|2
<EB>
```

6.4.1.3. Contents

No.	Field	Description	Len	Level; from TSM	Data Type
1	MSH-1	Field Separator Value: ASCII 124 (|) This field contains the separator between the segment ID and the first real field.	1	R	ST
2	MSH-2	Encoding Character Values: ASCII 94, 126, 92, and 38 (^~¥&) This field contains the four characters in the following order: the component separator, repetition separator, escape character, and subcomponent separator.	4	R	ST
3	MSH-3	Sending Application TSM fills name of itself as defined on Config/Host Communication Configuration.	180	R	HD
4	MSH-4	Sending Facility TSM fills facility name of itself as defined on Config/Host Communication Configuration.	180	R	HD
5	MSH-5	Receiving Application TSM fills name of LIS application as defined on Config/Host Communication Configuration.	180	R	HD
6	MSH-6	Receiving Facility TSM fills name of LIS facility as defined on Config/Host Communication Configuration.	180	R	HD
7	MSH-7	Date / Time of message TSM fills its system time. The format is "YYYYMMDDHHMMSS".	14	R	TS
8	MSH-9	Message Type Values: SSU^U03 Refer to this field to know what this message is.	7	R	CM

No.	Field	Description	Len	Level; from TSM	Data Type
9	MSH-10	Message Control ID This field contains a number or other identifier that uniquely identifies the message. The receiving system echoes this ID back to the sending system in the Message acknowledgment segment (MSA).	20	R	ST
10	MSH-11	Processing ID Values: P This two-component field, "Processing ID" and "Processing Mode", indicates how to process this message.	3	R	PT
11	MSH-12	Version ID Values: 2.3 This field is matched by the receiving system to its own version to be sure the message will be interpreted correctly.	8	R	ID
12	MSH-15	Accept Acknowledgment Type Value: 'NE', or 'ER' to keep track later. This field indicates the conditions under which accept acknowledgement is required to be returned in response to this message.	2	R	ID
13	MSH-16	Application Acknowledgment Type Value: 'NE', or 'ER' to keep track later. This field indicates the conditions under which application acknowledgement is required to be returned in response to this message.	2	R	ID
14	MSH-18	Character Set Values: 8859/1 The TSM supports only the character set 8859/1, which is the ISO descriptor for "Latin-1". The default character set ASCII (7-bit) is compatible with all other 8-bit character sets.	6	R	ID
15	EQU-1	Equipment Identifier Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> TSM uses 4th, 5th and 6th component of this field. 4th component is module ID. The value is 'IBM'. If multiple modules are controlled by TSM, numeric number is added to it. The length is up to 6 characters. 5th component is name of the module. The value is 'Input Buffer'. 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
16	EQU-2	Event date/time This field is the date/time that the event.	14	R	TS

No.	Field	Description	Len	Level; from TSM	Data Type
		The format is "YYYYMMDDHHMMSS".			
17	SAC-3	Container ID Primary Sample ID is filled to this field. TSM handles up to 16 characters itself. But if you control PAM and clinical chemistry analyser 7600 from TSM, 13 characters are the maximum length.	13 (16)	R	ST
18	SAC-7	Registration date/time This is the date/time when the instrument or module identifies/registers the sample status. The format is "YYYYMMDDHHMMSS".	14	R	TS
19	SAC-8	Container Status `Components:   <identifier (ST) > ^ <text (ST) > ^ <name of coding system (ST) > ^ <alternate identifier (ST) > ^ <alternate text (ST) > ^ <name of alternate coding system (ST) >` TSM uses 1st, 4th and 6th component. 1st component is sample status defined by NCCLS. Value is 'I' that means identified. 4th component is sample status defined by HITACHI. The value is A that means Arrived at PAM/CLAS2. 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
20	SAC-9	Carrier Type Value: 'HIT5' This means carrier type is HITACHI 5-position sample rack.	4	R	ST
21	SAC-10	Carrier Identifier TSM fills sample rack ID.	5	R	ST
22	SAC-11	Position in carrier TSM fills the position in the sample rack. The value is 1 through 5.	1	R	ST

6.4.2. On-line Aliquot Results

This message is uploaded when AQN makes aliquot for the target sample.   Whenever a rack is dispatched from AQN, TSM uploads this message for related samples to LIS.   So that, some same messages could be uploaded multiply.

LIS needs to use this message to know the mapping relation between sample ID and rack ID/position.

6.4.2.1. Structure
Refer to "6.4.1.1 Structure".

6.4.2.2. Example
TSM → LIS

```
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20010220201045||SSU^U03|307300093|P|2.3|||NE|NE||

8859/1
```

```
EQU|^^^AQN^Online Aliquoter^Hitachi|20010220201045

SAC||||10729413|||20010220201045|O^^^Q^^Hitachi|HIT5|5491|3||||2^^^1^Modular^H
itachi

<EB>

<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20010220201045||SSU^U03|307300140|P|2.3|||NE|NE||
8859/1

EQU|^^^AQN^Online Aliquoter^Hitachi|20010220201045

SAC|||1072924710|10729247|||20010220201045|O^^^Q^^Hitachi|HIT5|8269|3||||1^^^1
0^Gr1^Hitachi

<EB>
```

6.4.2.3. Contents

For the fields not listed in this matrix, please refer to "6.4.2.3 Contents".

No.	Field	Description	Len	Level; from TSM	Data Type
1	EQU-1	Equipment Identifier Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> This field identifies the equipment. TSM uses the identifier of the instrument. TSM uses 4th, 5th and 6th component of this field. 4th component is module ID. The value is 'AQN'. If multiple modules are controlled by TSM, numeric number is added to it. The length is up to 6 characters. 5th component is name of the module. The value is 'Online Aliquoter'. 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
2	SAC-3	Container ID Aliquot Sample ID is filled to this field. - Aliquot container with barcode: aliquot container ID is filled. This is mainly barcoded sample tube. - Aliquot container without barcode: nothing is filled. This is mainly sample cup that is not barcoded. TSM handles up to 16 characters itself. But, if you control PAM and Clinical Chemistry Analyser 7600 from TSM, 13 characters are the maximum length.	13 (16)	R	ST
3	SAC-4	Parent (Primary) Container ID Primary Sample ID is filled to this field. TSM handles up to 16 characters itself. But, if you	13 (16)	R	ST

No.	Field	Description	Len	Level; from TSM	Data Type
		control PAM and Clinical Chemistry Analyser 7600 from TSM, 13 characters are the maximum length.			
4	SAC-8	Container Status `Components:   <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text(ST)> ^ <name of alternate coding system (ST)>` TSM uses 1st, 4th and 6th component. 1st component is a sample status defined by NCCLS. Value is 'O' that means In Process. 4th component is sample status defined by HITACHI. The value is 'Q' that means the sample was successfully aliquoted. If aliquot is failed, F something can be taken as shown below.	80	R	CE

No.	Field	Description			Len	Level; from TSM	Data Type
		Err. Code	**Meaning for AQN**	**Action performed at AQS**			
		FA	Sample fluid surface is not found	Empty but labeled aliquot tube is sorted.			
		FB	Sample short	Empty but labeled aliquot tube is sorted.			
		FC	Clogged nozzle is detected on charging sample	Empty but labeled aliquot tube is sorted.			
		FD	Clogged nozzle is detected on discharging sample	Empty but labeled aliquot tube is sorted.			
		FE	Jam	Empty but labeled aliquot tube is sorted.			
		FF	Alarm is on	Empty but labeled aliquot tube is sorted.			
		FG	Communication Protocol is incorrect	Nothing.			
		FR	Detect the reused aliquot rack	Not empty but labeled aliquot tube is sorted. But rack re-use parameter should be set to YES. In order to avoid sample swapping between patient, HITACHI does not recommends using the sample for analysis. Therefore, LIS should not download test order to any analyzers for this sample.			
		FH	Nozzle was completely clogged	Empty but labeled aliquot tube is sorted.			
		6th component is the name of alternate coding system. The value is 'Hitachi'.					
5	SAC-15	Location Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> 1st component: Mechanical aliquot line#. The following values are taken:			80	R	CE

No.	Field	Description	Len	Level; from TSM	Data Type
		1: B line; mainly for standalone analyzers, barcoded tube 2: A1 line; mainly for clinical chemistry analyzer 3: A2 line; mainly for immunoassay analyzer 4th component: Aliquot Group # 5th component: Aliquot Group Name 6th component: Values is 'Hitachi'.			

6.4.3. Off-line Aliquot Results; UO-AR

This message is uploaded to LIS when AQF makes aliquot.   LIS needs to know this information to send test selection to standalone analyzers sequentially, or to identify a result belongs to which sample.

6.4.3.1. Structure
Refer to "6.4.1.1 Structure".

6.4.3.2. Example
```
## TSM → LIS
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20000324174711||SSU^U03|4848687|P|2.3|||NE|NE||8859/1
EQU|^^^AQF-1^Offline Aliquoter^Hitachi|20000324174711
SAC||||9804011234225|||20000324174711|R^^^Q^^Hitachi|AQF-RACK|32|2|||||1
<EB>
```

6.4.3.3. Contents
For the fields not listed in this matrix, please refer to "6.4.2.3 Contents".

No.	Field	Description	Len	Level; from TSM	Data Type
1	EQU-1	Equipment Identifier `Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)>` TSM uses 4th, 5th and 6th component of this field. 4th component is module ID. The value is 'AQF'. If multiple modules are controlled by TSM, numeric number is added to it. The length is up to 6 characters. 5th component is name of the module. The value is 'Offline Aliquoter'. 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
2	SAC-3	Container ID Always empty because aliquoted container does not have sample barcode ID. TSM handles up to 16 characters itself. But, if you control PAM and Clinical Chemistry Analyser 7600	13 (16)	R	ST

No.	Field	Description	Len	Level; from TSM	Data Type
		from TSM, 13 characters are the maximum length.			
3	SAC-4	Parent (Primary) Container ID Primary Sample ID is filled to this field. TSM handles up to 16 characters itself. But, if you control PAM and clinical chemistry analyser 7600 from TSM, 13 characters are the maximum length.	13 (16)	R	ST
4	SAC-8	Container Status `Components:  <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)>` TSM uses 1st, 4th and 6th component. 1st component is sample status defined by NCCLS. Value is 'R' that means Process Completed. 4th component is sample status defined by HITACHI. The value is 'Q' that means the sample was successfully aliquoted. If aliquot is failed, F something can be taken as listed below. Err. Code / Meaning for AQF table: FA — Sample fluid surface is not found FB — Sample short FC — Clogged nozzle is detected on charging sample FD — Clogged nozzle is detected on discharging sample FE — Jam FF — Alarm is on FG — Communication Protocol is incorrect FH — Nozzle was completely clogged 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
5	SAC-9	Carrier Type Value is 'AQF-RACK' that means rack of off-line aliquoter.	80	R	ST
6	SAC-10	Carrier Identifier Value: 0 through 9999	4	R	ST
7	SAC-11	Position in Carrier Value: 1 through 240	3	R	ST
8	SAC-15	Location `Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of`	80	R	CE

The table nested within SAC-8:

Err. Code	Meaning for AQF
FA	Sample fluid surface is not found
FB	Sample short
FC	Clogged nozzle is detected on charging sample
FD	Clogged nozzle is detected on discharging sample
FE	Jam
FF	Alarm is on
FG	Communication Protocol is incorrect
FH	Nozzle was completely clogged

No.	Field	Description	Len	Level; from TSM	Data Type
		`alternate coding system (ST)>` 1ˢᵗ component: Mechanical aliquot line#.			

6.4.4. Sample Sorting Results

6.4.4.1. Structure
Refer to "6.4.1.1 Structure".

6.4.4.2. Example
TSM → LIS
```
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20000311132947||SSU^U03|5260796|P|2.3|||NE|NE||88
59/1
EQU|^^^AQS-1^Aliquot Sorter^Hitachi|20000311132947
SAC|||4011234208001|9804011234208|||20000311132947|R|AQS-RACK|32|2||||1
SAC|||4011234208002|9804011234208|||20000311132947|R|AQS-RACK|33|2||||2
SAC|||4011234158001|9804011234158|||20000311132947|R|AQS-RACK|32|3||||1
SAC|||4011234158002|9804011234158|||20000311132947|R|AQS-RACK|33|3||||2
SAC|||4011234062001|9804011234062|||20000311132947|R|AQS-RACK|32|4||||1<EB>
```

6.4.4.3. Contents
For the fields not listed in this matrix, please refer to "6.4.2.3 Contents".

No.	Field	Description	Len	Level; from TSM	Data Type
1	EQU-1	Equipment Identifier `Components: <identifier (ST)>^<text (ST)>^<name of coding system (ST)>^<alternate identifier (ST)>^<alternate text (ST)>^<name of alternate coding system (ST)>` TSM uses 4ᵗʰ, 5ᵗʰ and 6ᵗʰ component of this field. 4ᵗʰ component is module ID. The value is 'AQS'. If multiple modules are controlled by the TSM, numeric number is added to it. The length is up to 6 characters. 5ᵗʰ component is name of the module. The value is 'Aliquot Sorter'. 6ᵗʰ component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
2	SAC-3	Container ID Aliquot sample ID is filled to this field if the sorted sample is aliquot sample. Primary sample ID is filled to this field if the sorted sample is primary sample. TSM handles up to 16 characters itself. But, if you control PAM and clinical chemistry analyser 7600 from the TSM, 13 characters are the maximum length.	13 (16)	R	ST
3	SAC-4	Parent (Primary) Container ID Primary Sample ID is filled to this field if aliquot	13 (16)	R	ST

No.	Field	Description	Len	Level; from TSM	Data Type
		sample is sorted. Nothing is filled if primary sample is sorted. TSM handles up to 16 characters itself. But, if you control PAM and clinical chemistry analyser 7600 from TSM, 13 characters are the maximum length.			
4	SAC-8	Container Status Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> TSM uses 1st component. 1st component is sample status defined by NCCLS. Value is 'R' that means Process Completed.	80	R	CE
5	SAC-9	Carrier Type Value is 'AQS-RACK' that means rack of Aliquot Sample Sorter	80	R	ST
6	SAC-10	Carrier Identifier Value: 0 through 9999	4	R	ST
7	SAC-11	Position in Carrier Value: 1 through 240	3	R	ST
8	SAC-15	Location Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> 1st component: Mechanical sort line#.	80	R	CE

6.4.5. Sample Arrival at Sample Stocker; UO-SSI

6.4.5.1. Structure
Refer to "6.4.1.1 Structure".

6.4.5.2. Example
```
## TSM → LIS
<SB>MSH|^~¥&|TSM|HII|LIS|RDC|20000311133535||SSU^U03|5608921|P|2.3|||NE|NE||88
59/1
EQU|^^^OBM^Output Buffer^Hitachi|20000311133535
SAC|||9804011234208||||20000311133535|R|HIT5|6118|1|OBM-TRAY|||1
SAC|||9804011234158||||20000311133535|R|HIT5|6118|2|OBM-TRAY|||1
SAC|||9804011234062||||20000311133535|R|HIT5|6118|3|OBM-TRAY|||1
SAC|||9804011234175||||20000311133535|R|HIT5|6118|4|OBM-TRAY|||1
SAC|||9804011234049||||20000311133535|R|HIT5|6118|5|OBM-TRAY|||1<EB>
```

6.4.5.3. Contents
For the fields not listed in this matrix, please refer to "6.4.2.3 Contents".

| No.	Field	Description	Len	Level; from TSM	Data Type
1	EQU-1	Equipment Identifier Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> TSM uses 4th, 5th and 6th component of this field. 4th component is module ID. The value is 'OBM'. If multiple modules are controlled by TSM, numeric number is added to it. The length is up to 6 characters. 5th component is name of the module. The value is 'Output Buffer'. 6th component is name of alternate coding system. The value is 'Hitachi'.	80	R	CE
2	SAC-3	Container ID Primary sample ID is filled to this field. TSM handles up to 16 characters itself. But, if you control PAM and 7600 from TSM, 13 characters are the maximum length.	13 (16)	R	ST
3	SAC-8	Container Status Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> TSM uses 1st component. 1st component is sample status defined by NCCLS. Value is 'R' that means Process Completed.	80	R	CE
4	SAC-9	Carrier Type Value is 'HIT5' that means HITACHI five position rack.	80	R	ST
5	SAC-10	Carrier Identifier Rack ID	4	R	ST
6	SAC-11	Position in Carrier Position in the rack.	3	R	ST
7	SAC-12	Tray Type Value: 'OBM-TRAY' that means tray of OBM – Output Buffer Module.	3	R	ST
8	SAC-15	Location Components: <identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)> 1st component: Mechanical tray # on OBM.	80	R	CE

7. How LIS interfaces to PAM and 7600

The sample containers for aliquot samples made at AQN then go to 7600, are sample cups. Because there is no barcode label on those sample cups, the LIS and the 7600 need to identify those samples by using rack ID and positions. The 7600 queries T/S – test selection by using aliquot rack ID and position within the rack as a combination key. In order to do so, LIS needs to store mapping information between table aliquot rack ID/position and sample ID when LIS receives aliquot result message from TSM.

7.1. Information System Layouts

This figure shows the information system layout between TSM, LIS and 7600. The number in figure is the sequence of messages in matrix of 7.2 Message and Trigger. If 7600-3 and more exist, its information flow is in the same manner with 7600-1 and 7600-2.
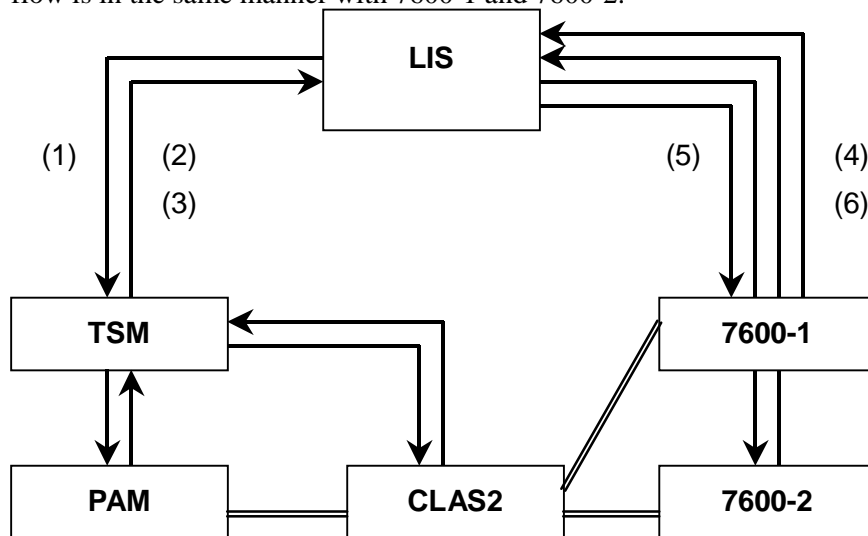
7.2. Message and Trigger

This matrix clarifies sequence, trigger event and contents of each message. To know the direction, please refer to the figure in 7.1 Information System Layouts. The sequence # in matrix meet with one in figure.

Seq#	Message	Trigger Events	Major Contents
(1)	T/S download	Depends on LIS; unsolicited	- SAC-3: Primary Sample ID - OBR-4: T/S – test selections
(2)	Sample arrival	Primary sample arrival at IBM of PAM	- SAC-3: Primary Sample ID - SAC-10: Primary Rack ID and SAC-11: position
(3)	Aliquot result	Primary sample aliquot at AQN of PAM	- SAC-4: Primary Sample ID of the aliquot sample - SAC-10: Aliquot Rack ID and SAC-11: position - SAC-8: Aliquot result - 1st or 4th component of SAC-15: Aliquot group to know aliquot line, i.e. to differentiate 7600-1 or 7600-2. In case of one MA, it is not needed.
(4)	T/S query	Aliquot sample arrival at MA	- Aliquot Rack ID and position[*1]
(5)	T/S download	4)	- Aliquot Rack ID and position - Primary Sample ID - T/S – test selections
(6)	T/R upload	All reactions are completed	- Aliquot Rack ID and position - Primary Sample ID

Seq#	Message	Trigger Events	Major Contents
			- T/R – test results

Notes,

1: When 7600 queries T/S – test selections for non-barcoded sample on sample ID mode, 7600 fills the sample ID field with asterisks ''.

7.3. What LIS needs to do

7.3.1. When LIS receives (3) Aliquot Result message

- LIS needs to store mapping information between Primary Sample ID and Aliquot Rack ID/position.
  According to these three information, LIS retrieves Primary Sample ID from Aliquot Rack ID and position on (5); when the 7600 sends a T/S query. On the communication text (4), 7600 sends Aliquot rack ID and position only, but does not send Primary Sample ID because aliquot sample cup does not have barcode ID. LIS needs to map the Aliquot Rack ID and the position back to Primary Sample ID to seek T/S – test selection.
- LIS needs to store Aliquot Result simultaneously.
  According to this information, LIS needs to make decision whether it should download T/S to 7600 later. If TSM tells the aliquot was unsuccessful, LIS reply an empty T/S to the query. The empty T/S means that LIS reply a message including no test order.
- LIS needs to store Aliquot Group information to know the aliquot rack i.e. aliquot sample goes to which 7600 if there are multiple 7600.
  By using aliquot group information, LIS knows which analyser the aliquot sample goes to later.

7.3.2. When LIS receives (4) T/S query message

- LIS needs to map Aliquot Rack ID and position on (4) T/S query message to its Primary Sample ID
- LIS retrieves T/S – test selections for the Primary Sample ID.
- If there are multiple 7600, LIS needs to use aliquot group to judge which 7600 the aliquot sample goes to.
- LIS retrieve T/S for the specific 7600 only.
- LIS downloads T/S to 7600 by message (5) if its aliquot result was aliquot success.