Communication mode:serial port or bluetooth

Serialsettings: 115200baud-rate, no parity bit, 8 data bits, 1 stop bit

Bluetoothsettings:Bluetooth 2,and bluetooth name is device number

PC set sends "MSG_ERGODIC" command to the analyzer to get all the packets.

"*" indicates a different place with the standard LIS protocol.

Interface Communication Protocol

The HL7 interface provides a communication channelfor the chemical analyzer and LIS of the hospital.Using the serial port or bluetooth, the function of this interface includes transmission of sample information and test results. LIS spontaneously sends the sample information to the analyzer, and then the analyzertests the sample locallyafter obtaining the sample information from LIS. After the test is completed, the analyzer transmits the results to LIS in real time.The transmission format of the data is created according to the 2.3.1 version of HL7.

The format of the message is "<SB>*ddddd*<EB><CR>", the note is as follows:

<SB>is hexadecimal, <0x0B>;

ddddd = Data (variable number of bytes)

*ddddd*is message ofHL7, and just include hexadecimal data(20~FF) and<CR>.

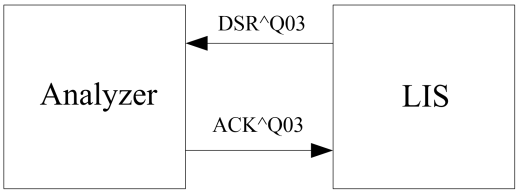
<EB> is hexadecimal, <0x1C>

<CR> is hexadecimal, <0x0D>

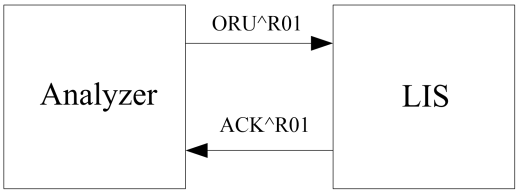
Three types of HL7 messages are used: ORU, ACK and DSR.

Diagrammatic sketches are as follows:

1) transmission of sample information



2) transmission of test results



The specific structure of the message "ORU^R01"is as follows:

MSH	headers
PID	patient information
OBR	sample information
{OBX}	test results

The specific structure of the message "ACK^R01"is as follows:

MSH	headers

MSA message confirmation
[ERR] error message

The specific structure of the message “DSR^Q03”is as follows:

MSH headers
MSA message confirmation
[ERR] error message
[QAK] query validation
QRD query definition
[QRF] query filter
{DSP} display data
[DSC] continuous pointer

The specific structure of the message “ACK^Q03”is as follows:

MSH headers
MSA message confirmation
[ERR] error message

“[ ]”is optional
“{ }”is repeatable

Below is the structure of fields used by each message section:

Firstis the message header MSH. “(aaa)” is expressed as a fixed value“aaa”.

No.	Field name	Length	Description
1	Field Separator	1	（|）
2	Encoding Characters	4	（^~\&）
3	Sending Application	180	(1)
4	Sending Facility	180	CelercareV or PointcareV
5	ReceivingApplication	180	Reserve
6	Receiving Facility	180	Reserve
7	Date/TimeOfMessage	26	Call system data and time information
8	Security	40	Version ID of the custom protocol
9	Message Type	7	Message type, such as “ORU^R01”
10	Message Control ID	20	Message ID, the unique identity of Message. The first message is “1”, the second message is “2”, and so on.
11	Processing ID	3	(p)
12	Version ID	60	(2.3.1)Version ID of HL7
13	Sequence Number	21	Sequence Number (Device Sequence Number)
14	Continuation Pointer	180	Reserve
15	Accept Acknowledgment Type	2	(P) Valid only for “DSR^Q03”

16	Application Acknowledgment Type	2	(0) Valid only for “ORU^R01”
17	Country Code	2	Reserve
18	Character Set	10	Character set, use ASCII
19	Principal Language Of Message	60	Reserve
20	Alternate Character Set Handling Scheme	20	Reserve

Remarks: This section will appear in all messages. When LIS sends a message to the analyzer, the third and fourth fields are formulated by LIS developer.When LIS automatically sends the sample information to the biochemical analyzer, the fifteenth field needs to be set to "P".

PID section is mainly used to construct the patient's personal information.

No.	Field name	Length	Description
1	Set ID – PID	10	Sample’s unique code
2	Patient ID	20	Patient ID
3	Patient Identifier List	20	Patient Identifier List
4	Alternate Patient ID – PID	20	Bed number
5*	Patient Species	48	Patientspecies
6	Patient Name	48	Patient name
7*	Master Name	48	Master name
8	Mother’s Maiden Name	48	Inpatient Area
9	Date/Time of Birth	26	Date of birth(YYYYMMDDHHmmSS)
10	Sex	1	Sex: male “M”; female “F”; Neutral “N” Other “O”
11	Patient Alias	48	Blood type
12	Race	80	Reserve
13	Patient Address	106	Patient Address
14	County Code	4	County Code
15	Phone Number - Home	40	Phone Number
16	Phone Number - Business	40	Reserve
17	Primary Language	60	Reserve
18	Marital Status	80	Reserve
19	Religion	80	Reserve
20	Patient Account Number	20	inpatient / outpatient / other
21	SSN Number	16	Medical insurance account

	-Patient		
22	Driver's License Number – Patient	25	Charge type
23	Mother's Identifier	20	Reserve
24	Ethnic Group	80	Ethnic Group
25	Birth Place	60	Birth Place
26	Multiple Birth Indicator	1	Reserve
27	Birth Order	2	Reserve
28	Citizenship	80	Remarks
29	Veterans Military Status	60	Reserve
30	Nationality	80	Nationality
31	Patient Death Date and Time	26	Reserve
32	Patient Death Indicator	1	Reserve

The "OBR"section is used to transmit the medical advice and other information of the patient sample.

No.	Field name	Length	Description
1	Set ID – OBR	10	Distinguish between different “OBR” fields
2	Placer OrderNumber	22	Sample bar code
3	Filler Order Number	22	Sample test number
4	Universal Service ID	200	（1^1)
5	Priority	2	Whether emergency, yes “Y”, no “N”
6	RequestedDate/time	26	Reserve
7	ObservationDate/Time	26	Test time
8	Observation End Date/Time	26	Reserve
9	Collection Volume	20	Reserve
10	Collector Identifier	60	Reserve
11	Specimen ActionCode	1	Reserve
12	Danger Code	60	Reserve
13	Relevant ClinicalInfo	300	Relevant Clinical Info of patient
14	Specimen Received Date/Time	26	Specimen ReceivedDate/Time
15	Specimen Source	300	Sample type: whole blood, plasma, serum
16	Ordering Provider	120	Fetch Doctor
17	Order CallbackPhone Number	40	Fetch Department
18	Placer Field 1	60	“icterus”, “hemolysis”, “lipemia”
19	Placer Field 1	60	Blood bag number

20	Filler Field 1	60	Attending doctor
21	Filler Field 2	60	Treatment department
22	Result Rpt/Status Change – Date/Time	26	Reserve
23	Charge to Practice	40	Reserve
24	Diagnostic Serv Sect ID	10	Reserve
25	Result Status	1	Reserve
26	Parent Result	200	Reserve
27	Quantity/Timing	200	Reserve
28	Result Copies To	150	Reserve
29	Parent	150	Reserve
30	Transportation Mode	20	Reserve
31	Reason for Study	300	Reserve
32	Principal Result Interpreter	200	Reserve
33	Assistant Result Interpreter	200	Reserve
34	Technician	200	Reserve
35	Transcriptionist	200	Reserve
36	ScheduledDate/Time	26	Reserve
37	Number of Sample Containers	4	Reserve
38	Transport Logistics of Collected Sample	60	Reserve
39	Collector'sComment	200	Reserve
40	TransportArrangement Responsibility	60	Reserve
41	Transport Arranged	30	Reserve
42	Escort Required	1	Reserve
43	Planned Patient Transport Comment	200	Reserve
44*	LOT	60	LOT
45*	PanelID	106	Panel id
46*	PanelLot	48	Panel lot
47*	Panelindex	106	Panel unique code

Remarks: The 45 fields represent the ID number of the panel, which is defined in the following table

Project name	ID
Preanesthetic Panel	51

Critical Care Panel	52
Health Checking Profile	55
Electrolytes	57
Liver & Kidney Profile	60
Liver Profile	61
Kidney Profile	62
Preanesthetic Panel Plus	63
Triple tests profile (3)	65
Large Animal Diagnostics	66
Ammonia test Profile	67
Avian & Reptile Panel	68
GLU & Lipid & HCY Profile	69
Diabetes Panel	73
Equine Profile	75
Health Checking Plus Profile	77
TBA Profile	79
Comprehensive Profile (24)	82
Blood Gas Profile	86
Pancreatitis Profile	87
Health Checking Plus Profile	88

The 46 fields represent the panellot, for example: 181250

The 47 fields represent the encoding of each panel, for example:1

“OBX” is used to send the testresults. One patient can have more than one “OBX”.

No.	Field name	Length	Description
1	Set ID – OBX	10	Distinguish between different “OBX” fields
2	Value Type	3	“ST” (string)
3	ObservationIdentifier	590	Observation identifier, used as test item ID
4	Observation Sub-ID	20	Observation Sub-ID，used as test itemname
5	Observation Value	65536	Test result
6	Units	90	Unit of test items
7	References Range	90	References Range
8	Abnormal Flags	5	Determine whether the test results in the reference range “L”- Low “H”- High “N”- normal
9	Probability	5	Reserve
10	Nature of Abnormal Test	2	Reserve

11#	Observe ResultStatus	1	Reserve
12	Date Last Observe Normal Values	26	Reserve
13	User Defined Access Checks	20	Reserve
14	Date/Time of the Observation	28	Test time
15	Producer's ID	60	Reserve
16	Responsible Observer	80	ResponsibleObserver, test physician
17	Observation Method	60	Reserve
18*	Lower limit	20	Linear lower bound
19*	Upper limit	20	Linear upper bound

Below is the structure of fields used by “MSA” section:

No.	Field name	Length	Description
1	AcknowledgmentCode	2	Fixed “AA”. “AA” is acceptance; “AE” is error; “AR” is rejection
2	Message Control ID	20	Message control ID, be same with the sender’s “MSH-10”
3	Text Message	80	When error or rejection appears, a text description of the event. Corresponding to the sixth field. Can be used to write error log.
4	Expected Sequence Number	15	Reserve
5	Delayed AcknowledgmentType	1	Reserve
6	Error Condition	100	Status code

Note: MSA-6field status table

Status code（**MSA-6**）	Text Message（**MSA-3**）	Description
Succeed:		AA
0	Message accepted	Succeed
Error status code:		AE
100	Segment sequenceerror	The segment sequence of the message is not correct
101	Required fieldmissing	Some required fieldmissing
102	Data type error	Data type error
103	Table value not found	Table value not found,temporarily not used
Rejection status code:		AR
200	Unsupportedmessage type	Unsupportedmessage type
201	Unsupported eventcode	Unsupported eventcode
202	Unsupportedprocessing id	Unsupportedprocessing id

203	Unsupported versionid	Unsupported versionid
204	Unknown keyidentifier	Unknown keyidentifier
205	Duplicate keyidentifier	Duplicate keyidentifier
206	Application recordlocked	Such as Database locked
207	Application internalerror	Other internalerrors

“ERR” section is used to add an error note in the confirmation message:

No.	Field name	Length	Description
1	ErrorCodeandLocation	80	Error code and location

The “QAK” section contains some information about the following query response:

No.	Field name	Length	Description
1	Query Tag	32	(SR),representing the sample information
2	QueryResponse Status	2	“OK”: Data found, no errors “NF”: No data found, no errors “AE”: Application error “AR”: Application reject

Below is the structure of fields used by “QRD” section. “(aaa)” is expressed as a fixed value“aaa”.

No.	Field name	Length	Description
1	Query Date/Time	26	The querytime, call system time
2	Query Format Code	1	（R)
3	Query Priority	1	（D)
4	Query ID	10	Query ID
5	Deferred ResponseType	1	Reserve
6	Deferred Response Date/Time	26	Reserve
7	Quantity LimitedRequest	10	（RD)
8	Who Subject Filter	60	Sample bar code
9	What Subject Filter	60	（OTH)
10	What Department Data Code	60	Reserve
11	What Data Code Value Qual	20	Reserve
12	Query Results Level	1	Reserve

“QRF”and “QRD” sections are together used to further refine the original query content. “(aaa)” is expressed as a fixed value“aaa”.

No.	Field name	Length	Description
1	Where Subject Filter	20	CelercareV or PointcareV
2	WhenDataStart Date/Time	26	Starting Specimen ReceivedDate/Time

3	When Data End Date/Time	26	Ending Specimen ReceivedDate/Time
4	What User Qualifier	60	Reserve
5	Other QRY Subject Filter	60	Reserve
6	Which Date/Time Qualifier	12	(RCT)
7	Which Date/Time Status Qualifier	12	(COR)
8	Date/Time Selection Qualifier	12	(ALL)
9	WhenQuantity/Timing Qualifier	60	Reserve

The “DSP” section is used to give a display sample information and patient information, which can be repeated.

No.	Field name	Length	Description
1	Set ID - DSP	4	“DSP” section ID
2	Display Level	4	Display level
3	Data Line 300	300	Data rows, the query contents
4	Logical Break Point	2	Logical break point
5	Result ID	20	Result ID

Remarks: The third field "Line Data" is used to display the sample information downloaded from the LIS server. The details of the sample information are shown in the following table.

No.	Content	Type and value
1	Patient Identifier List	String
2	Bed Number	String
3*	Patient Species	String （cat,dog,horse,cow,ox,rabbit,elephant,goat,monkey,sheep,pig,mouse,these species have reference range. other species have no reference range）
4*	Patient Name	String
5*	Master Name	String
6	Date of Birth	String, format is: “YYYYMMDDHHmmSS” (year/month/day/hour/minute/second)for example: 20061122130540. All time fields are in this format.
7	Sex	String, Sex: male “M”; female “F”; Neutral “N” Other “O”
8	Patient Alias	String, blood type: “O”, “A”, “B”, “AB”
9	Race	Reserve
10	Patient Address	String
11	County Code	String

12	Home Phone Number	String
13	Business Phone Number	Reserve
14	Primary Language	Reserve
15	Marital Status	Reserve
16	Religion	Reserve
17	Patient Account Number	String, “outpatient”, “inpatient”, “Other”
18	Social Security Number	String
19	Driver License Number	String, Charge type: “own”, “insurance”
20	Ethnic Group	String
21	Birth Place	String
22	Nationality	String
23	Bar Code	String
24	Sample ID	int
25	Sample Time	String
26	Priority	String, Whether emergency, yes “Y”, no “N”, blank “N”.
27	Collection Volume	Float, blank
28	Sample Type	String, “serum”, “plasma”, “whole blood”
29	Fetch Doctor	String
30	Fetch Department	String
31	TestID^TestName^Unit^Normal Range	String^string^string^string

Remarks:The analyzer only saves field 1 patient identifier list, field 3 patient species, field 4 patient name, field 5 mastername, fileld 6 date of birth,fileld 7 sex,field 28 sample type, and returns it to LIS system after biochemical test.

The “DSC” section is used to indicate the last data in the sending sample information.

No.	Field name	Length	Description
1	Continuation pointer	180	Continuation pointer

Note: because there is only sample information, the “DSC” sectionin the “DSR” message isempty.

Communication use case

(1) LIS sends the information of a patient to the analyzer, using the “DSR^Q03” message, the patient information is as follows:

Field name	Information data
Patient Identifier List	8
Patient Species	dog
Patient Name	maomao
Master Name	John Smith
Date/Time of Birth	2005.10.03
Sex	male
Sample type	serum

The message is:

<SB>MSH|^~\&|||1|PointcareV|20121026132318|2|DSR^Q03|1|p|2.3.1|||P|||ASCII|||<CR>

MSA|AA|1|Message accepted|||0|<CR>

ERR|0|<CR>

QAK|SR|OK|<CR>

QRD|20121026132318|R|D|1|||RD||OTH|||T|<CR>

QRF|PointcareV|20121026122321|20121026122321|||RCT|COR|ALL||<CR>

DSP|1||8|||<CR>

DSP|2||||<CR>

DSP|3||dog|||<CR>

DSP|4||maomao|||<CR>

DSP|5||John Smith|||<CR>

DSP|6||20051003000000|||<CR>

DSP|7||M|||<CR>

DSP|8||||<CR>

DSP|9||||<CR>

DSP|10||||<CR>

DSP|11||||<CR>

DSP|12||||<CR>

DSP|13||||<CR>

DSP|14||||<CR>

DSP|15||||<CR>

DSP|16||||<CR>

DSP|17||||<CR>

DSP|18||||<CR>

DSP|19||||<CR>

DSP|20||||<CR>

DSP|21||||<CR>

DSP|22||||<CR>

DSP|23||||<CR>

DSP|24||||<CR>

DSP|25||||<CR>

DSP|26||||<CR>

DSP|27||||<CR>

DSP|28||serum|||<CR>

DSP|29||||<CR>

DSP|30||||<CR>

DSP|31|||||<CR><EB><CR>

The whole data packet is transmitted to theanalyzer by data flow.After received the“DSR^Q03”message, if the data is complete, the analyzer will make a reply confirmation. The message is:

<SB>MSH|^~\&|1|PointcareV|||20121026132420|2|ACK^Q03|1|p|2.3.1|||||ASCII|||<CR>

MSA|AA|1|Message accepted|||0|<CR>ERR|0|<CR><EB><CR>

If the data is not correct, the analyzer will send the error code.The message is:

<SB>MSH|^~\&|1|PointcareV|||20121026132420|2|ACK^Q03|1|p|2.3.1|||||ASCII|||<CR>

MSA|AE|1|Segment sequence error|||100|<CR><EB><CR>

When received the error code,LIS will resend the data.

(2) After thetest being done, the test data will be sent to LIS, using the "ORU^R01" message, the test data is as follows:

Field name	Information data
Patient Identifier List	8
Patient Species	dog
Patient Name	maomao
Master Name	John Smith
Date/Time of Birth	2005.10.03
Sex	male
Sample type	serum
Test itemname	TP,GLU,BUN,ALT,ALP,CRE
Test result	60,5,5,50,100,100
Unit of test items	g/L, mmol/L,mmol/L, U/L,U/L, umol/L
References Range	54-82, 4-7, 2.9-8.9, 10-118, 20-150,27-115
Linear range	0-1000, 0-1000, 0-1000, 0-1000, 0-1000, 0-1000, 0-1000, 0-1000, 0-1000

The “ORU^R01” message which the analyzer sends to LIS is:

<SB>MSH|^~\&|1|CelercareV|||20121026132318|2|ORU^R01|1|p|2.3.1|PV3456789012 992 21|||0||ASCII|||<CR>

PID|1||8||dog|maomao|John Smith||20051003000000|M|||||||||||||||||||<CR>

OBR|1||8|1^1|||20121026132153|||||||serum|||||||||||||||||||||||||51|181250|1|<CR>

OBX|1|ST||TP|60|g/L|54-82|N|||||60|20121026132153||||0|1000|<CR>

OBX|2|ST||GLU|5|mmol/L|4-7|N|||||5|20121026132153||||0|1000|<CR>

OBX|3|ST||BUN|5|mmol/L|2.9-8.9|N|||||5|20121026132153||||0|1000|<CR>

OBX|4|ST||ALT|50|U/L|10-118|N|||||50|20121026132153||||0|1000|<CR>

OBX|5|ST||ALP|100|U/L|20-150|N|||||100|20121026132153||||0|1000|<CR>

OBX|6|ST||CRE|100|umol/L|27-115|N|||||100|20121026132153||||0|1000|<CR><EB><CR>

The whole data packet is transmitted to LIS by data flow.

After received the“ORU^R01”message, if the data is correct, LIS will make a reply confirmation. The message is:

<SB>MSH|^~\&|||1|PointcareV|20121026132420|2|ACK^R01|1|p|2.3.1|||||ASCII|||<CR>

MSA|AA|1|Message accepted|||0|<CR>ERR|0|<CR><EB><CR>

If the data is not correct, LIS will send the error code.The message is:

<SB>MSH|^~\&|||1|PointcareV|20121026132420|2|ACK^R01|1|p|2.3.1|||||ASCII|||<CR>

MSA|AE|1|Segment sequence error|||100|<CR><EB><CR>

When received the error code, the analyzer will resend the data.