The Universal Connectivity Standard
for Point-of-Care

www.poccic.org

Draft Technical Specifications
January 8, 2001

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Point-of-Care Connectivity Industry Consortium

CONTEXT

The Connectivity Industry Consortium (CIC) has been hard at work since February 22, 2000 drafting proposals to standardize Point-of-Care (POC) connectivity. This document contains the Consortium's draft proposals, circa January 8, 2001. The Consortium will continue to revise these specifications until the CIC's sunset, planned for the end of February 2001.

VISION

"The vision of the CIC is to expeditiously develop, pilot and transfer the foundation for a set of seamless 'plug and play' POC communication standards, ensuring fulfillment of the critical user requirements of bi-directionality, device connection commonality, commercial software interoperability, security, and QC/regulatory compliance."

STRUCTURE

The CIC is an open, non-profit, industry-driven consortium comprised of device manufacturers, information system vendors and health care providers. It is chartered to address impediments to POC device connectivity with the objective of enabling seamless information exchange between POC devices and electronic medical records and laboratory information systems. Where possible, the consortium will leverage existing standards. The CIC does not intend to become a chartered standards development body. Rather, the Consortium plans to work with existing standards organizations to ensure the CIC standards are transferred to a chartered standards body for publication, extension, and maintenance.

TIMELINE

The CIC has limited itself to a 12-15 month lifetime. The Consortium will complete its development work in early 2001. At the CIC's sunset, these developed standards will be transferred to chartered standards organizations for maintenance.

CIC DRAFT PROPOSALS

TABLE OF CONTENTS
January 8, 2001

The following sections contain the most recent draft proposals for the CIC's Device and EDI interfaces. **These sections are included for informational purposes only**. The CIC's technical teams are currently working to revise and extend these proposals.

You may always view the most current publicly available CIC proposals on the Consortium's website: www.poccic.org. If you have any questions or comments on these proposals, please send them by e-mail to info@med.labs.agilent.com.

DRAFT – Device Access Point (Lower-Layer) Proposal

DRAFT – Device Upper-Layer Proposal

DRAFT – EDI Interface Proposal

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CONNECTIVITY INDUSTRY CONSORTIUM (CIC)

The Universal Standard for Point of Care Connectivity

DEVICE AND ACCESS POINT INTERFACE

Transport and Physical Layer Draft Specification

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TABLE OF CONTENTS

1 Document Scope and Objectives

This standard specifies the lower-layer communication protocols and physical interfaces for 'point-of-care' (POC) *Devices* and *Access Points.*

This standard specifies the use of a single transport protocol (IrDA TinyTP) running over either of two physical layers: *IrDA-infrared*, as specified by the Infrared Data Association (IrDA), and *cable-connected*, as specified by the IEEE Medical Information Bus (MIB) lower-layers standard IEEE Standard 1073.3.2 and Draft International Standard ISO 18813.

This standard also specifies how a *network access point* acts as a relay between the TinyTP connection to the Device and a TCP/IP connection to a Data Manager on the network, and how the services of one or more POC Data Managers can be *registered* at a network access point. This solution places most of the burden of finding, binding and communicating with the appropriate network services on the access point rather than the device.

Although not formally required by this standard, a key objective is that it should be possible to build a *Common Access Point* that can support POC, MIB and handheld PDA devices, regardless of differences between their upper-layer protocols and applications. The availability of a Common Access Point infrastructure that could support POC, MIB and handheld PDA devices in all patient care areas would be a major benefit to clinicians and would accelerate the adoption of this standard.

Recommendations regarding remote modem access are also provided, based on the IrDA infrastructure and protocols defined by this document.

2 Overview of POC Device Networking (informative)

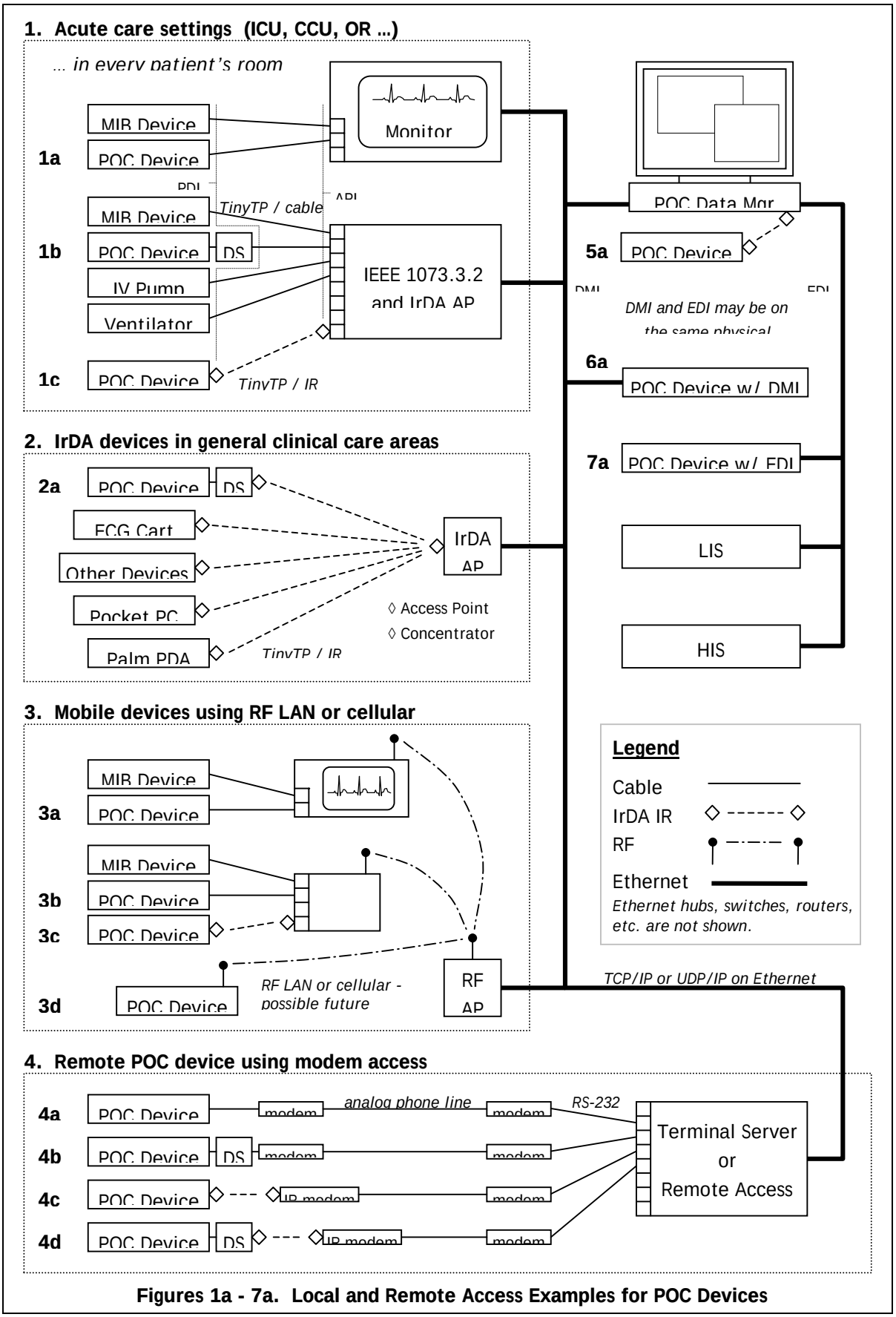
A 'POC System' is defined as a collection of one or more devices and subsystems that can perform a POC measurement in the patient care area and report the results using an 'Electronic Data Interchange' (EDI) interface to a hospital 'Laboratory Information System' (LIS), 'Hospital Information System' (HIS) or other system that is the final repository for the POC measurement results. In most installations, the EDI interface uses the HL7 upper-layer protocol running over a network TCP/IP connection.

Devices, subsystems and principal interfaces (highlighted in gray) that comprise a POC System are defined below in the order of data flow from a POC Device to a Laboratory Information System (LIS).

PD	A '**POC Device**' performs the blood chemistry and other measurement(s) in the patient care area.
DS	A '**Docking Station**' may be used to provide a mechanical and electrical interface that supports the POC Device. The docking station may use a legacy mechanical interface, connector, protocol and power delivery methods. *The docking station is optional*.
PDI	The POC Device or its Docking Station uses its '**POC Device Interface**' to communicate its data (principally output) to an Access Point Interface.
API	The '**Access Point Interface'** specifies the interface (principally input) to an Access Point or Concentrator.
AP	The '**Access Point**' or '**Concentrator**' consolidates the data from one or more Devices onto another communication link, possibly using a different physical layer and transport protocol*. This subsystem is optional.* Examples of an Access Point are listed below, and other implementations are permitted: (a) a multi-port concentrator, typically connected to a local area network (LAN); (b) a dedicated single-port access point, typically connected to a LAN; and (c) an access point that is part of a multifunctional device such as a personal computer.
DMI	The '**Data Manager Interface**' specifies the TCP/IP network interface to a Data Manager.
DM	A '**Data Manager**' performs such functions as (1) device data storage and forwarding, (2) QA/QC and (3) other vendor specific functionality.
EDI	The '**EDI Interface**', typically provided by the Data Manager, is used to report the results to a hospital 'Laboratory Information System' (LIS), 'Hospital Information System' (HIS) or other system that is the final repository for the POC measurement results. The EDI interface typically uses HL7 over a network TCP/IP connection.

Figures 1a - 7a on the following page illustrate how POC devices, subsystems and their principal interfaces can be used in a typical hospital environment, including remote-access configurations that employ modems and analog phone lines. This figure depicts many of the common scenarios that the CIC has identified for possible standardization, but is not meant to preclude other configurations, such as connecting a device in a home through a personal computer.

Although not shown on the diagram, multiple vendor-specific Data Managers can coexist on the network, and the CIC standard allows a Device to communicate with a *vendor-specific* or *generic* Data Manager.



Figures 1a - 7a. Local and Remote Access Examples for POC Devices

3 Overview of IrDA and IEEE 1073.3.2 (informative)

This section provides an overview of the Infrared Data Association (IrDA) and IEEE Standard 1073.3.2 on which most of this standard is based. References to these standards are listed in Section 9.

3.1 IrDA Protocol Stack Summary

Communication protocol layering is consistent with IrDA-Data standards, as shown below.

Related ISO OSI Layer	
Service Access Points	5-6
Transport	4
Network	3
Data Link	2
Physical Link	1

IrDA and IEEE 1073.3.2 Layers

<table>
<tr><td rowspan="2">IrLMP
IAS</td><td>CIC:POC:MGR SAP</td><td>Other SAPs …</td></tr>
<tr><td colspan="2">TinyTP: Tiny Transport Protocol</td></tr>
<tr><td colspan="3">IrLMP: Link Management Protocol</td></tr>
<tr><td colspan="3">IrLAP: Link Access Protocol</td></tr>
<tr><td>Cable-connected</td><td colspan="2">Infrared</td></tr>
<tr><td>IEEE 1073.3.2</td><td>IrDA SIR</td><td>IrDA FIR …</td></tr>
</table>

The components of the stack are briefly as follows.

Physical layer – defines a standard connector and electrical characteristics.

IEEE 1073.3.2: cable-connected, RS-232; default: 9600 Bd, negotiated: 19.2, 38.4, 57.6, 115.2 kBd.

IrDA 'Serial Infrared' (SIR): default: 9600 Bd, negotiated: 19.2, 38.4, 57.6, 115.2 kBd.

IrDA 'Fast Infrared' (FIR): default: 9600 Bd, negotiated: 576, 1152, 4000 kBd (optional).

This standard, as well as IEEE 1073.3.2, specifies signaling speeds consistent with IrDA SIR [default 9600 Bd and optional negotiated signaling speeds of 19.2, 38.4, 57.6 and 115.2 kBd]. An infrared access point may also support the optional IrDA FIR speeds [576, 1152 and 4000 kBd].

IrLAP – provides a device-to-host connection for the reliable, ordered transfer of data, including device discovery procedures.

IrLMP – provides multiplexing of the IrLAP layer and device information via the device's *Information Access Services* database of available services, the **IrLMP-IAS** (or simply the **IAS**).

Tiny TP – provides flow control on IrLMP connections and negotiated optional segmentation and reassembly.

***CIC:POC:MGR* SAP** – an IrDA 'service access point' that provides a TCP/IP connection to a 'CIC POC Data Manager'.

Additional SAPs may be defined in the Information Access Service (IAS) directory of the Access Point or Device. These include SAPs that support other application protocols such as the IEEE 1073 Medical Data Device Language (MDDL); IEEE 1073 Simple Network Time Protocol (SNTP); and IrDA IrCOMM serial port emulation for infrared-modems or network access using the Point-to-Point (PPP) protocol.

This standard, as well as IEEE 1073.3.2, requires that both the Device and Access Point support the IrDA protocol stack layers IrLAP, IrLMP, IrLMP-IAS and TinyTP.

3.2 IEEE Std 1073.3.2 Cable-Connected Physical Layer

This section summarizes the essential requirements and capabilities of IEEE Std 1073.3.2 cable-connected physical layer. Unless otherwise noted, IEEE Std 1073.3.2 shall be the authoritative specification for the CIC cable-connected physical layer standard.

The IEEE Std 1073.3.2 specifies a *point-to-point cable connection* between a 'Device Communication Controller' (DCC) and a 'Bedside Communication Controller' (BCC). The relationship between the terminology used by this CIC standard and IEEE Std 1073.3.2 is summarized below; the CIC terminology will be used in this standard unless otherwise noted.

CIC:	**Device**				**Access Point**	
CIC:	'POC Device Interface'	PDI	API		'Access Point Interface'	DMI
IEEE:	'Device Communication Controller'	DCC	BCC		'Bedside Communication Controller'	Network

The following section summarizes the key requirements for the CIC cable-connected physical layer and is fully compliant with the physical layer defined in IEEE Std 1073.3.2:

1. RS-232 signaling levels over unshielded twisted pair (UTP) Category-5 cable;
2. RS-232 signaling speeds: 9600 Bd and optional negotiated speeds of 19.2, 38.4, 57.6 and 115.2 kBd;
3. Octet encoding: start bit, eight data bits, no parity bit, one stop bit; and
4. An 8-pin RJ-45 modular connector at the Access Point (BCC/API) using the pin assignments shown in the table below. The POC Device or Docking Station Interface (DCC/PDI) may use (1) an RJ-45 connector with the pinout shown below, (2) any other connector or pinout appropriate to the clinical use of the device, or (3) a permanently attached cable.

Access Point (BCC/API)	**Pin and signal direction**	**Function**	**Device (DCC/PDI)**
*b*RD+	1 ⇐	*DPWR / 10/100BASE-T*	*d*DPWR / *d*TD+
*b*RD-	2 ⇐	*BCC sense / 10/100BASE-T*	*d*CS- / *d*TD-
*b*CS+ / *b*TD+	3 ⇒	*DCC sense / 10/100BASE-T*	*d*RD+
*b*GND	4 ⇔	*Signal Ground*	*d*GND
*b*RxD	5 ⇐	*RS-232*	*d*TxD
*b*CS- / *b*TD-	6 ⇒	*DCC sense / 10/100BASE-T*	*d*RD-
*b*TxD	7 ⇒	*RS-232*	*d*RxD
*b*BPWR	8 ⇒	*BPWR*	*d*BPWR

Pinout Notes:

The RxD, TxD, and GND signals support the RS-232 serial data interface. BPWR and DPWR provide power for a line accessory or a DCC. CS and DPWR provide connection sensing.

This standard is compatible with a 10/100BASE-T interface, supported by the RD± and TD± signals (pins 1-2 and 3-6). A BCC port may be designed to support the ability to detect an IEEE 1073.3.2 (RS-232) connection or a 10/100BASE-T connection, and to communicate with either device. [However, 10/100BASE-T functions for BCCs and DCCs are currently out of the scope of the IEEE 1073.3.2 standard.]

A BCC can sense the connection of a DCC by testing the resistance across its *b*CS+ and *b*CS- pins. The alternative names *b*TD+ and *b*TD- indicate the 10/100BASE-T transmit data function.

A DCC may provide power on its *d*DPWR line to a line-extender or communications adapter. A DCC can sense its connection to a BCC by testing the resistance between its *d*DPWR and *d*CS- pins. The alternative names *d*TD+ and *d*TD- indicate the 10/100BASE-T transmit data function.

This section summarizes the *optional* capabilities for the CIC cable-connected physical layer for the CIC standard and are consistent with the recommendations provided by IEEE Std 1073.3.2:

5. IEEE Std 1073.3.2 specifies three DC power delivery options the BCC/API and DCC/PDI:

Zero-power	The BCC or DCC does not provide power.
Low-power	The BCC or DCC offers power levels that are typically provided by the parallel connection of RTS || DTR or a single RTS or DTR pin of a standard RS-232 communications port. This can be used to power line isolators and extenders.
High-power	The BCC or DCC offers DC power of +5.0 V ±5% @ 100 mA. This can be used for powering a wide range of devices that have modest power requirements.

   IEEE Std 1073.3.2 provides a detailed discussion of the three DC power options. Although complete interoperability would require a single DC power delivery option (e.g. 'high-power'), the ability to communicate with a standard serial port using a passive adapter was also considered an essential requirement by the IEEE 1073.3.2 subcommittee, and hence the 'zero-power' and 'low-power' options were created. *In order to promote the highest degree of cable-connected POC and MIB Device interoperability, it is recommended that the 'high-power' option be implemented at the Access Point.*

6. IEEE Std 1073.3.2 also defines additional optional physical layer capabilities, such as the ability of an Access Point to sense the connection of a Device and the ability of a Device to sense its connection to an Access Point, without requiring the sensed entity to be powered. This capability can be used to provide an informative messages to the user such as 'please turn on the device' or 'communication error'. Implementation of the terminating impedance (or short) in the DCC/PDI and BCC/API is mandatory, but implementation of the detection circuitry is optional.

7. IEEE Std 1073.3.2 is compatible with the RJ-45 pinout for 10BASE-T as defined in Clause 14 of ISO/IEC 8802-3-1996 and IEEE Std 802.3-1998, and 100BASE-TX for unshielded twisted pair cable as defined in Clause 25 of IEEE Std 802.3-1998. The two standards, 10BASE-T and 100BASE-TX, are collectively referred to as '10/100BASE-T' in this document. Implementation of either of these physical layers is not required nor has a complete set of IEEE 1073 protocol(s) been defined for them at the present time.

8. The maximum recommended IEEE Std 1073.3.2 cable length is 20 meters, based on the electrical properties of the cable and connectors and use of the 'high-power' DC power delivery option.

9. IEEE Std 1073.3.2 provides guidelines for physical media marking and color (yellow).

Although a non-isolated connection between the Device (DCC/PDI) and Access Point (BCC/API) is permitted by IEEE Std 1073.3.2, it is highly recommended that at least one component (either the DCC/PDI, BCC/API or a cable adapter) provide electrical isolation if direct connection to the patient could occur or in situations where 'ground-loops' would compromise communications reliability.

3.3 IrDA 'Primary' and 'Secondary' Roles

IrDA IrLAP communication partners act in one of two roles: there is one *primary* station and one or more *secondary* stations. The primary station *discovers* all available secondary stations and typically establishes a connection to a specific secondary station (although more than one is possible).

At the lower IrLAP protocol layer, the primary station is always the initiator of the data transfer and the secondary station reacts to commands from the primary. At the IrLMP and TinyTP layers, however, the master/slave nature of IrLAP is hidden from the application and a symmetrical set of services is provided, regardless of whether a station participates as a *primary* or *secondary*.

IEEE Standard 1073.3.2 and IrDA-compatible PDAs such as the Palm or PocketPCs use different conventions for assigning IrDA primary and secondary roles to devices and access points. Although operation as an IrDA primary or secondary is generally hidden from applications that use the IrDA IrLMP and TinyTP protocol layers, differences do exist, and are addressed in this section.

3.3.1 IEEE Std 1073.3.2

IEEE Std 1073.3.2 uses the following IrDA primary and secondary conventions:

- the Device Communications Controller (DCC) participates as a IrDA *secondary* station and
- the Bedside Communications Controller (BCC) participates as an IrDA *primary* station.

The BCC periodically performs IrDA *discovery* to see if a DCC is attached to the cable, possibly as frequently as every one or two seconds.

The IrDA *secondary* role assigned to the DCC and *primary* role assigned to the BCC are appropriate for the acute-care settings that IEEE Std 1073.3.2 is intended to be used for the following reasons:

1. The BCC can poll the DCC in a deterministic manner. This is critical in the acute-care setting where it is necessary to have second-by-second parameter and alarm updates from ventilators and heart-rate monitors.
2. The BCC, as the *client* (initiator and controlling entity) requests data from the DCC, which acts as the *data server* (source of data) during the session. This fits the IrDA client-server model with the BCC participating as a primary and the DCC participating as a secondary station.
3. DCCs are often memory constrained and thus benefit from the smaller secondary IrDA stack size.
4. Provides a broadcast capability, at least per BCC.
5. Allows the BCC to communicate with multiple DCCs [1]. Although point-to-multipoint communication is not supported by the cable-connected topology specified by IEEE Std 1073.3.2 nor is it currently specified by the IrDA standards, this capability would be useful for a multi-device POC download station.

[1] The IrDA standards specify how a primary station can *discover* multiple secondary stations, and communicate with them one at a time. The IrDA standards currently do not specify how point-to-multipoint communication should be performed, but this capability could be added at a later date.

3.3.2 PDA and LAN Access Point

A PDA and LAN Access Point use the following IrDA primary and secondary conventions:

- the Palm or PocketPC participates as an IrDA *primary* station and
- the LAP participates as an IrDA *secondary* station.

The Palm or PocketPC initiates the transaction as a *client* by performing IrDA *discovery* and the LAP passively waits for the request on behalf of the *server* on the network in a *client-server* relationship.

The IrDA *primary* role assigned to the PDA and *secondary* role assigned to the LAP are also appropriate for POC data transfer for the following reasons:

1. The PDA, as the initiator of the client-server data exchange, contends for access to the IR medium only when it has something to transfer. This minimizes IR traffic that could interfere with other IR devices.
2. The PDA, as the IrDA primary, can rapidly access the LAP services since it does not need to wait for the discovery polling interval (if the LAP was an IrDA primary station).
3. These roles (PDA as primary and LAP as secondary) represent industry-standard practice for the majority of IrDA-compatible devices (including printers and modems) described in the IrDA 'Point and Shoot' profile [2].

3.3.3 Common Access Point

Based on the discussion above, two conventions have been used for assigning IrDA primary and secondary roles for devices and access points. The section explores how both conventions can be incorporated into a 'Common Access Point' that can support IEEE MIB, CIC POC and handheld PDA devices.

In order to support IEEE 1073.3.2 cable-connected DCCs (devices) as IrDA secondaries and handheld PDAs or POC devices as IrDA primaries, the 'Common Access Point' (CAP) should be able to function either as an IrDA primary or secondary station, depending on the type of device that attempts to communicate with it. It should be noted that many IrDA devices are capable of participating as IrDA primary or secondary stations, so implementing this capability in an access point should not be difficult.

Although supporting both roles places an additional burden on the CAP, it provides the greatest flexibility to the POC device designer, where limited memory size and processor capability may be major issues. A POC Device that has ample memory can participate as an IrDA primary, consistent with how handheld PDAs communicate with LAN Access Points. As an IrDA primary, the POC Device would be able to rapidly establish a connection with the CAP since the POC Device would not have to wait for the 'discovery polling interval'.

A POC device that has limited memory could instead participate as an IrDA *secondary*, similar to a IEEE Std 1073.3.2 DCC (device communication controller). A relatively short *discovery polling interval* (~ one second) could be used with the cable-connected RS-232 physical layer specified by this standard, allowing rapid discovery of the POC or MIB device.

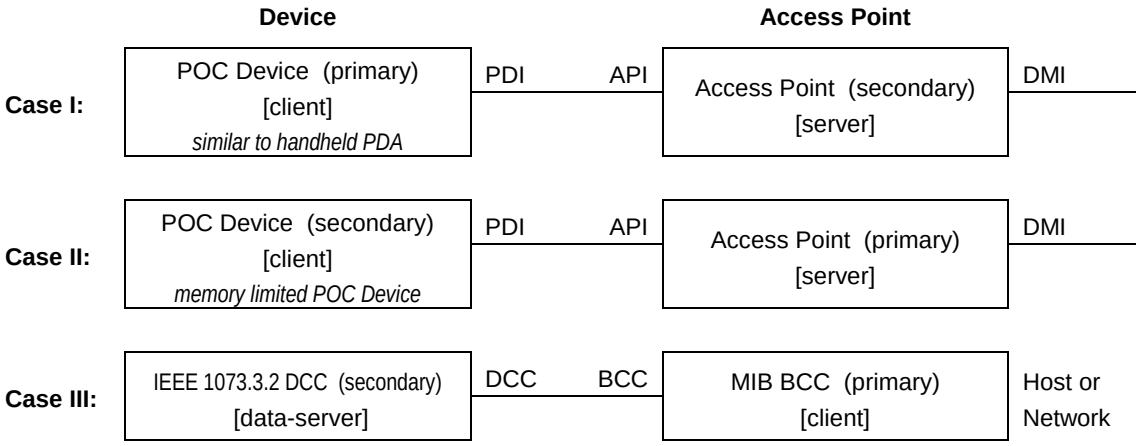
3.4 Client-Server Model for POC Device Communication

Three cases of client-server and primary-secondary need to be considered.

[2] Infrared Data Association 'Point and Shoot Profile', Version 1.0, January 12, 2000; available from IrDA at http://www.irda.org/standards/specifications.asp .

Cases I and II summarize how the POC Device participates as the client and the Access Point participates as (or represents) the server in a client-server relationship, regardless of which entity is the IrDA primary or secondary. Both are supported and specified by this standard.

Case III summarizes how an IEEE 1073.3.2 DCC participates as the data-server (and IrDA secondary) and the BCC participates as the client (and IrDA primary). This case can coexist with but is not required by this standard. A step-by-step protocol walk-through for this case is provided in IEEE Std 1073.3.2.



4 Requirements for a 'CIC-compatible' Device (normative)

This clause defines the physical, transport layer, IrDA IAS entries and additional requirements for the POC Device Interface (PDI) of a 'CIC-compatible' POC Device or POC Device and Docking Station.

Unless otherwise stated, the required, recommended, optional and default options and parameters for IEEE 1073.3.2 shall apply to the *cable-connected* physical layer and IrDA SIR shall apply to the *infrared* physical layer.

4.1 Device Physical Layer Requirements

A 'CIC-compatible' POC Device or POC Device and Docking Station shall support *at least one* of the physical layer options listed below:

1. ***CABLE-CONNECTED PRIMARY DEVICE***

   Uses the physical layer defined in IEEE 1073.3.2 and participates as an IrDA primary.

2. ***CABLE-CONNECTED SECONDARY DEVICE***

   Uses the physical layer defined in IEEE 1073.3.2 and participates as an IrDA secondary.
   [This configuration is used by an IEEE 1073.3.2 Device Communication Controller (DCC).]

3. ***INFRARED PRIMARY DEVICE***

   May use either 'standard' or 'low-power' IrDA SIR and participates as an IrDA primary.
   [This configuration is typically used by a handheld PDA that initiates a communication session.]

4. ***INFRARED SECONDARY DEVICE***

   May use either 'standard' or 'low-power' IrDA SIR and participates as an IrDA secondary.

   An *infrared secondary* Device shall respond to discovery command frames issued by the Access Point only if the Device needs to communicate with a Data Manager or a sufficient amount of time has elapsed since the previous transmission. The purpose of this requirement is to prevent subsequent 're-discovery' of the Device immediately after it has sent its data.

A *cable-connected* POC Device or POC Device and Docking Station may use (1) a RJ-45 connector with the device (DCC) pinout defined by IEEE 1073.3.2, (2) any other connector or pinout appropriate to the clinical use of the device or (3) a permanently attached cable. The cable end that connects to the Access Point shall be terminated with an RJ-45 plug using the BCC pinout defined by IEEE 1073.3.2.

A *cable-connected* POC Device or POC Device and Docking Station may not assume that a particular DC-power delivery option is available from an Access Point (BCC) port.

An *infrared* POC Device shall support either the IrDA SIR 'standard' or 'low-power' option; the latter option is capable of supporting link distances up to 20 cm and typically requires LED drive currents of 10 mA (average) and 30 mA (peak).

For *cable-connected* and *infrared*, the default signaling rate of 9600 Bd shall be supported and the optional higher rates of 19200, 38400, 57600 and 115200 Bd may be negotiated, consistent with the IEEE 1073.3.2 and IrDA SIR standards (2400 Bd is excluded by IEEE 1073.3.2 and this standard).

4.2 Device Transport Layer and IAS Requirements

A POC Device or POC Device and Docking Station shall support the IrLAP, IrLMP, IrLMP-IAS and TinyTP protocols.

The CIC POC Device IAS shall include the object class 'CIC:POC:DEV', and it is highly recommended this object class contains the 'Global ID' attribute for the device. The 64-bit 'global identifier number' (EUI-64) consists of a 3-octet (24 bit) company identifier assigned by the IEEE Registration Authority Committee (RAC) followed by a 5-octet (40 bit) extension identifier assigned by the manufacturer. This information can be used for Device tracking and inventory management, independent of the Device upper-layer application protocols.

The principal difference between the CIC standard and IEEE 1073.3.2 is that the CIC POC Device does not provide an device upper-layer protocol connection endpoint such as the 'IEEE:1073.3.2:MDDL' object class since it is a 'client' and not a 'data server'. Instead, the CIC POC Device (as a client) accesses the 'CIC:POC:MGR' object class in the Access Point IAS that specifies the service connection to the IrDA TinyTP service representing the Data Manager (the server). In the case of a networked Access Point, this would result in the establishment of a TCP/IP connection to a POC Data Manager on the network.

The mandatory and recommended IAS objects and attributes for a CIC POC Device are shown below.

Table 1 – IAS Objects and attributes for a POC Device (PDI)

Object class	Attribute name	Value type	Description	IAS Status [a]
Device	DeviceName [b]	user string	This attribute is described in IrLMP.	M
	IrLMPSupport	octet sequence	This attribute is described in IrLMP.	M
CIC :POC :DEV [d]	GlobalID	octet sequence	Specifies the global identifier number for the POC Device.	R [c]
	NodeType	integer	1 (= Device) [e]	M
	PortNumber	integer	Ascribes a specific number to each port on the POC Device.	M
	PollInterval	integer	Indicates the Device's preferred polling interval, in ms. May be 0, 50, 100 or 250.	O [c]

Notes:

[a] IAS Status: 'M' is Mandatory, 'R' is Recommended, 'O' is Optional.

[b] Examples of device names and nicknames include "CIC Glucose", "CIC Blood Analyzer", etc.

[c] If the capability is not supported, the attribute shall be omitted from the IAS.

[d] Although the CIC:POC:DEV object class duplicates the functionality of the 'IEEE:1073:3:2' object class, using a different object class identifier provides one way of allowing a device to support both the CIC and MIB upper-layer protocols. The object class attributes are defined in IEEE Std 1073.3.2.

[e] An Access Point would have a 'NodeType' of 0.

Additional Requirements and Recommendations for a Device:

Discovery information: Service hint bit 12 and extension bit 7 shall be asserted, in addition to any other hint bits that are set (it should be noted that not all IrDA devices that assert hint bit 12 support the CIC or IEEE 1073.3.2 standard). The 'device nickname' is a short, recognizable name for the device, preferably starting with the word "CIC" followed by a space. For example, the nickname and device name "CIC Glucose" or "CIC Blood Analyzer" could be used. The programmatic test for whether a particular IAS service exists is by IAS Object Class such as "CIC:POC:DEV".

5 Requirements for a 'CIC-compatible' Access Point (normative)

This clause defines the physical, transport layer, IrDA IAS entries and additional requirements for the Access Point Interface (API) of a 'CIC-compatible' Access Point.

Unless otherwise stated, the required, recommended, optional and default options and parameters for IEEE 1073.3.2 shall apply to the *cable-connected* physical layer and IrDA SIR shall apply to the *infrared* physical layer.

5.1 Access Point Physical Layer Requirements

An *infrastructure* of 'CIC-compatible' Access Points shall be capable of supporting *all* the physical layer options listed below. *Individual* Access Points that support only *cable-connected* or *infrared* are permitted, and may support the alternative physical layer as an adapter option. **It should be noted, however, that POC Devices are strictly free to use either the *cable-connected or infrared* physical layers, and may participate in a communication session either as an IrDA *primary or secondary* device.**

1. ***CABLE-CONNECTED SECONDARY AP***

   Uses the physical layer defined in IEEE 1073.3.2 and participates as an IrDA secondary.

2. ***CABLE-CONNECTED-PRIMARY AP***

   Uses the physical layer defined in IEEE 1073.3.2 and participates as an IrDA primary.
   [This configuration is used by a IEEE 1073.3.2 Bedside Communication Controller (BCC).]

   A *cable-connected-primary* Access Point may use a short *discovery polling interval* (~ one second) to detect a secondary device since the discovery procedure cannot interfere with other IR devices in the room. [In fact, IEEE Std 1073.3.2 recognizes this property of the cable-connected topology and recommends that the BCC provide only a single time slot to minimize the time spent during the discovery process, and the same strategy could be used for POC Devices as well.]

3. ***INFRARED-SECONDARY AP***

   May use either 'standard' or 'low-power' IrDA SIR and participates as an IrDA secondary.
   [This configuration is typically used by an IrDA-compatible LAN access point that passively waits for incoming discovery requests from POC and handheld PDA IrDA primary devices.]

4. ***INFRARED-PRIMARY AP***

   May use either 'standard' or 'low-power' IrDA SIR and participates as an IrDA primary.

   An *infrared-primary* Access Point may use a somewhat longer discovery polling interval (~ two seconds) to minimize unnecessary interaction with other infrared devices within its vicinity.

   An *infrared-primary* Access Point may employ other strategies to preferentially accept connection requests by CIC POC Devices by examining the IrDA 'service hint bits' and 'device nickname' returned by the Device in response to the discovery command frame issued by the Access Point.

An Access Point may provide one or more *cable-connected* ports, a single *infrared* transceiver, or *both* in a given patient care area. An Access Point may support multiple *infrared* transceivers provided they are located in distinct IR 'spaces'.

A *cable-connected* port on an Access Point shall be compatible with the requirements for a BCC port defined by IEEE 1073.3.2-2000, including the use of an RJ-45 modular jack with the BCC pinout.

A *cable-connected* port on an Access Point may provide any of the three DC power delivery options. [The 'high-power' option (+5V at 100 mA) would provide the highest degree of interoperability with other IEEE 1073.3.2 devices.]

An *infrared* port on an Access Point shall support either the IrDA SIR 'standard' or 'low-power' option; the 'standard' IR-power option is recommended for an Access Point since it will support somewhat longer link distances (30 cm vs. 20 cm) when used with a 'low-power' IrDA device.

For *cable-connected* and *infrared*, the default signaling rate of 9600 Bd shall be supported and the optional higher rates of 19200, 38400, 57600 and 115200 Bd may be negotiated, consistent with the IEEE 1073.3.2 and IrDA SIR standards (2400 Bd is excluded by IEEE 1073.3.2 and this standard). An *infrared* port may also support the IrDA FIR signaling rates 576, 1152, 4000 kBd and higher signaling rates.

As previously described, a *cable-connected* Access Point port may use a relatively short *discovery polling interval* (~ one second) to detect nearby secondary devices since the discovery procedure cannot interfere with other IR devices in the room. An *infrared* Access Point port should use a somewhat longer *discovery polling interval* (~ two seconds) to minimize unnecessary interaction with other IR devices in its vicinity. For either physical layer, the *discovery polling interval* shall comply with the media access rules described in the IrDA IrLAP specification. Specifically, an Access Point or POC Device in the 'contention state' must ensure that there is no activity on the link for a time period greater than 500 ms (560 to 600 ms recommended) before attempting to transmit (usually the XID discovery frame). In order to allow a *primary device* to transmit an XID discovery frame at the end of the 600 ms inactivity period, it is recommended that the *access point* wait at least an additional 400 ms (for a total of 1000 ms of inactivity) before transmitting an XID discovery frame.

5.2 Access Point Transport Layer and IAS Requirements

The Access Point shall support the IrLAP, IrLMP, IrLMP-IAS and TinyTP protocols, and each port shall run a separate instance of the IrDA transport protocol stack.

The Access Point IAS shall include the object class 'IEEE:1073:3:2', and it is highly recommended the object class contains the 'Global ID' and 'PortNumber' attributes that uniquely identify a specific port on an Access Point. This information can be accessed by the Device and incorporated into the information it sends to the POC Data Manager to facilitate device tracking.

The Access Point IAS shall provide the object class 'CIC:POC:MGR:GENERIC' with the attribute name 'IrDA:TinyTP:LsapSel' which returns an integer to the Device that specifies the service connection endpoint to an IrDA TinyTP service representing the POC Data Manager. Vendor-specific IAS object classes such as 'CIC:POC:MGR:*VENDORNAME*' are permitted by this standard.

The mandatory and optional IAS objects and attributes for an Access Point are shown below.

Table 2 – IAS objects and attributes in an Access Point

Object class	Attribute name	Value type	Description	IAS Status [a]
Device	DeviceName	user string	This attribute is described in IrLMP.	M
	IrLMPSupport	octet sequence	This attribute is described in IrLMP.	M
IEEE :1073:3:2	GlobalID	octet sequence	Specifies the global identifier number for the BCC / Access Point.	M
	NodeType	integer	0 (= BCC / Access Point)	M
	PortNumber	integer	Ascribes a specific number to each port on the BCC / Access Point.	M
CIC :POC :MGR :GENERIC	IrDA:TinyTP :LsapSel	integer	Specifies the service connection endpoint for the CIC POC Device protocol to an IrDA TinyTP service representing a *generic* POC Data Manager.	M
CIC :POC :MGR :VENDOR [b]	IrDA:TinyTP :LsapSel	integer	Specifies the service connection endpoint for the CIC POC Device protocol to an IrDA TinyTP service representing a *vendor-specific* POC Data Manager.	O *multiple entries are permitted*

Notes:

[a] IAS Status: 'M' is Mandatory, 'R' is Recommended, 'O' is Optional.

[b] The sub-string 'VENDOR' is a vendor-specific string such as 'LFS' (Lifescan), 'ROCHE', 'I-STAT', etc. These would need to be registered with the CIC or other registration authority. The maximum length for an object class name is 60 octets.

Additional Requirements and Recommendations

Discovery information: Service hint bit 12 and extension bit 7 shall be asserted, in addition to any other hint bits that are set (it should be noted that not all IrDA devices that assert hint bit 12 support the CIC or IEEE 1073.3.2 standards). The 'device nickname' is a short, recognizable name for the access point, preferably starting with the word "MIB" followed by a space. For example, the nickname and device name "MIB BCC" could be used for a dedicated IEEE 1073.3.2 concentrator. The programmatic test for whether a particular IAS service exists is by IAS Object Class such as "IEEE:1073:3:2" or "CIC:POC:MGR:GENERIC".

6 Networked Access Points (normative if implemented)

Up to this point, the requirements for a 'CIC-compatible' POC Device and Access Point have dealt solely with the PDI and API interfaces, and provide a complete specification of the transport and physical layers relevant to POC Device communication, regardless of the how the Access Point is implemented.

In this section, the use of *networked access points* will be discussed. One of the key technical objectives of this effort was to maintain the simplicity of using the IrDA IAS as the mechanism that allows a small medical device to 'find-and-bind' to the appropriate network services it needs. The burden of actually locating these services is placed on the Access Point, which typically has the CPU and memory resources to perform this task.

6.1 Transparent TinyTP to TCP/IP Connection

A key requirement for a *networked* Access Point is that it can transparently bridge the TinyTP protocol used by a POC Device to a TCP/IP network connection, as shown below.

After the POC Device initiates a TinyTP connection to the Access Point, the Access Point establishes a TCP/IP connection to the POC Data Manager on behalf of the POC Device request. TinyTP and TCP/IP provide robust, bidirectional data transfer with flow control mediated by all three subsystems.

6.2 Registering Data Managers in the Access Point IAS

The IrDA Information Access Service (IAS) of the Access Point plays a critical role in establishing the connection to the server. The IAS must first be configured by 'registering' the IAS Service Object Class and server IP Address and TCP Port Number for each network server and service port. After the services have been registered, POC Devices connected to the Access Point need only perform a simple IAS lookup to 'find-and-bind' to the servers and services they need.

IAS Service Object Class (visible to POC Device)	**Server IP Address and TCP Port Number** (internally stored in the Access Point)
CIC:POC:MGR:GENERIC	(128.9.0.32, 1184)
CIC:POC:MGR:VENDORA	(128.9.0.32, 1184)
CIC:POC:MGR:VENDORB	(128.9.0.34, 1184)
additional entries …	

Vendor-specific suffixes may also be registered to allow a POC Device to select a particular POC Data Manager on the network. This allows a variety of policies to be implemented in a multi-vendor POC device and manager network, but these are beyond the scope of this standard. Note that it is possible to register other services such as LIS server or other medical data servers and services.

It is beyond this scope of this standard to specify the protocol used to 'register' the servers and services in the IAS of the Access Point. The 'Simple Network Management Protocol' (SNMP) would be appropriate since it is widely used to configure network equipment such as bridges, routers and access points. It is highly recommended that an Access Point support the registration of multiple services, perhaps globally for all ports as well as individually for selected ports. Data Managers should not abuse this capability by registering a large number of vendor-specific services.

6.3 Control and Data Flow between a Device, Access Point and Data Manager

The following table illustrates the control and data flow between a POC Device **PD** as an IrDA *secondary*, an Access Point **AP** as an IrDA *primary* and a Data Manager **DM**.

POC Device (IrDA secondary)		**Access Point** (IrDA Primary)		**Data Manager**	**Protocol**	**Comments**
	←	XID			IrDA LAP	LAD discovery
XID	→				IrDA LAP	PD discovery response with nickname and hint bits
	←	XID			IrDA LAP	AP ending discovery with hint bits and nickname
	←	SNRM			IrDA LAP	connection parameter negotiation
UA	→				IrDA LAP	Parameter negotiation
LSAP connect request	→				IrDA LM	LLSAP connection request to LSAP 0 (IAS server port)
	←	LSAP connect confirm			IrDA LM	LSAP connect confirm
I frame	→				IrDA LM	IAS service query
	←	I frame			IrDA LM	IAS service reply with LSAP number
LSAP connect request	→				IrDA LM	TinyTP Connection request to the LSAP returned
		SYNC	→		TCP	AP tries to open a TCP connection to DM, this is the first TCP SYNC packet of the 3 way handshake
			←	SYNC ACK	TCP	This is the second packet of the 3 way handshake
		ACK	→		TCP	This is the third packet of the 3 way handshake, a TCP connection is up
	←	LSAP connect confirm			IrDA LM	TinyTP connection confirm to PD.
data	→				IrDA TinyTP	Data from PD
		data	→		TCP	AP forwards the data to DM
			←	data	TCP	DM sends some data back to PD
	←	data			IrDA TinyTP	AP forwards the data to PD
		… …				
RD	→				IrDA LAP	PD sends out 'Request Disconnect' command to AP
		FIN	→		TCP	AP starts the 3 way handshake to end the TCP connection
		FIN ACK	←		TCP	Second packet of the 3 way handshake
		ACK	→		TCP	Third packet of the 3 way handshake
	←	DISC			IrDA LAP	AP sends 'Disconnect' command to PD
UA	→				IrDA LAP	PD ack. IrDA connection is now torn down.

The Access Point sends out discovery packets with a predetermined interval. After a secondary device is found, the Access Point checks the hint bits and nickname of the secondary device. If it is a POC Device, the Access Point waits for the IAS query instead of initiating an IAS query as it normally would do with non-CIC devices. After receiving the LSAP connection request, the Access Point opens a TCP connection with the Data Manager. If the TCP connection is successfully opened, the Access Point then sends back the LSAP connection confirm message to POC Device. At this point, the POC Device has an IrDA TinyTP connection and the Access Point has a TCP connection with the Data Manager.

The following table illustrates the control and data flow between a POC Device **PD** as an IrDA *primary*, an Access Point **AP** as an IrDA *secondary* and a Data Manager **DM**.

POC Device (IrDA primary)		**Access Point** (IrDA Secondary)		**Data Manager**	**Protocol**	**Comments**
XID	→				IrDA LAP	PD discovery
	←	XID			IrDA LAP	AP discovery response with nickname and hint bits
XID	→				IrDA LAP	PD ending discovery with hint bits and nickname
SNRM	→				IrDA LAP	connection parameter negotiation
	←	UA			IrDA LAP	Parameter negotiation
LSAP connect request	→				IrDA LM	LLSAP connection request to LSAP 0 (IAS server port)
	←	LSAP connect confirm			IrDA LM	LSAP connect confirm
I frame	→				IrDA LM	IAS service query
	←	I frame			IrDA LM	IAS service reply with LSAP number
LSAP connect request	→				IrDA LM	TinyTP Connection request to the LSAP returned
		SYNC	→		TCP	AP tries to open a TCP connection to DM, this is the first TCP SYNC packet of the 3 way handshake
			←	SYNC ACK	TCP	This is the second packet of the 3 way handshake
		ACK	→		TCP	This is the third packet of the 3 way handshake, a TCP connection is up
	←	LSAP connect confirm			IrDA LM	TinyTP connection confirm to PD.
data	→				IrDA TinyTP	Data from PD
		data	→		TCP	AP forwards the data to DM
			←	data	TCP	DM sends some data back to PD
	←	data			IrDA TinyTP	AP forwards the data to PD
		… …				
DISC	→				IrDA LAP	PD sends out 'Disconnect' command to AP
		FIN	→		TCP	AP starts the 3 way handshake to end the TCP connection
		FIN ACK	←		TCP	Second packet of the 3 way handshake
		ACK	→		TCP	Third packet of the 3 way handshake
	←	UA			IrDA LAP	AP ack. IrDA connection is now torn down.

The differences between the two tables are in the IrDA discovery phase and IrDA connection tear down phase. The POC Device, whether it is an IrDA secondary or primary, is always the initiator. It starts the IAS query, makes TinyTP connection request and tears down the IrDA connection.

Abbreviations used in this section:

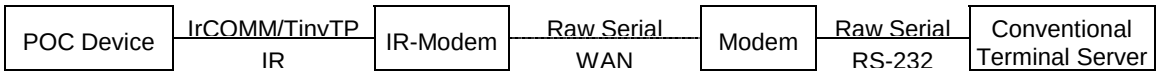
PD: POC Device
AP: Access Point
DM: Data Manager
LAP: IrDA Link Access Protocol
XID: Exchange Station Identification, IrDA control frame
SNRM: Set Normal Response Mode, IrDA control frame
UA: Un-numbered Acknowledgment, IrDA control frame
IAS: Information Access Service, IrDA protocol
LSAP: Link Service Access Point, IrDA protocol

7 Remote Modem Access (informative)

This section explores two examples of remote access that utilize the IrDA-based infrastructure and protocols described earlier in this document.

7.1 Raw Serial over WAN

One method for providing remote modem access is to use an 'IR-modem' and conventional modem. The POC Device uses the IrDA 'IrCOMM' protocol and the 'IR-modem' sends the data as a raw serial character stream to the second modem and conventional serial-line concentrator that ultimately forwards the data to the appropriate network server.

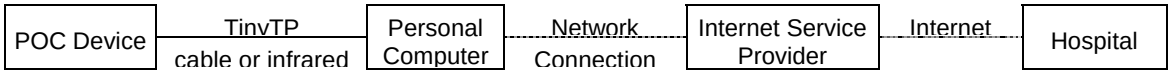


Since the POC Device does not have access to the IAS of an 'IrDA-smart' Access Point, 'finding-and-binding' is accomplished by having the Device or IR-modem dial the appropriate number and by preconfiguring the appropriate IP address and TCP port number for the POC Data Manager into the serial-line concentrator.

The principal advantage of this method is that it can utilize the existing infrastructure of conventional terminal servers and that it is relatively easy to install in the patient's home. Adding IrCOMM to an otherwise 'CIC-compatible' device that already supports TinyTP is not difficult since IrCOMM runs above TinyTP. Also, the POC Device can determine whether IrCOMM support is available simply by interrogating the IAS of the IR-modem.

7.2 Home PC as an Access Point

A growing number of remote patient care areas such as the home will have personal computers with network access. Eventually it will become more economical and convenient to integrate an IrDA transceiver and software into an existing personal computer (either as a 'network access point' or as part of a program that the patient uses for POC data logging and self-management of diet and medication) than it would be to implement the IR-modem solution described in the previous section.



As shown above, the POC Device can use a cable or infrared connection (using an IR adapter) to a personal computer. The PC can send the data via an existing connection to an Internet service provider to the hospital or other clinical site.

8 Definitions and Abbreviations

AP *Access Point,* a subsystem that consolidates data from one or more POC Devices onto another communication link. Examples of access points include a multi-port concentrator or a dedicated single-port access point, typically connected to a local area network (LAN), or an access point that is part of a multifunctional device such as a patient monitor or personal computer.

API *Access Point Interface* (CIC definition, equivalent to IEEE 'BCC'), specifies the interface (principally input) to an Access Point or concentrator.

BCC *Bedside Communication Controller* (IEEE definition, equivalent to CIC 'API').

CAP *Common Access Point*, an Access Point that can service MIB, POC and handheld PDA devices.

CIC *Connectivity Industry Consortium*, a consortium organized in February 2000 to specify, recommend and develop communication protocols for 'point-of-care' medical devices.

DCC *Device Communication Controller* (IEEE definition, equivalent to CIC 'PDI').

DHCP *Dynamic Host Configuration Protocol* [RFC-2131].

DM *Data Manager*, typically a network server that performs such functions as POC data storage and forwarding, QA/QC and other POC instrument and data management functions.

DMI *Data Manager Interface*, specifies the TCP/IP network interface and protocol between a Data Manager and one or more Access Points.

DS *Docking Station,* a mechanical and electrical interface that supports the use of a POC Device, typically employing legacy mechanical interfaces, connectors, protocols and power delivery methods.

EDI *Electronic Data Interchange,* a network interface and protocol that specifies how the Data Manager reports its results to a hospital 'Laboratory Information System' (LIS), 'Hospital Information System' (HIS) or other system that is the final repository for the POC measurement results. The EDI interface typically uses HL7 over a network TCP/IP connection.

IAS *Information Access Service*, advertises capabilities of IrDA devices. Also termed **IrLMP-IAS**.

IEEE *The Institute of Electrical and Electronics Engineers*, which among its many roles sets standards for the electronics industry such as IEEE Std 1073 for Medical Device Communications, IEEE Std 802.3 which forms much of the lower-layers foundation for the Internet, and many other standards.

IR *Infrared*, the physical layer typically used by IrDA devices.

IrDA *Infrared Data Association*; also, refers to the protocol stack authored by that group.

MDDL *Medical Data Device Language*, used as the upper-layer protocol for IEEE 1073 MIB Devices.

MIB *Medical Information Bus*, IEEE Std 1073 and lower-layers IEEE Std 1073.3.2.

MIB *Management Information Base* [RFC-1213 'MIB-II' and related RFCs].

NTP *Network Time Protocol* [RFC-1305], principal high-resolution time-distribution and synchronization protocol on the Internet.

POC *Point of Care*, typically refers to blood chemistry and other measurements performed at or near the patient rather than by a centralized hospital laboratory.

PD *POC Device*, refers to a device that is capable of performing blood chemistry and other measurements in patient care areas.

PDI *POC Device Interface* (CIC definition, equivalent to IEEE 'DCC'), specifies the interface (principally output) of a POC Device or its Docking Station to an Access Point.

PPP *Point-to-Point Protocol,* a protocol for framing IP datagrams over a serial line.

SAP *Service Access Point (*or **LSAP**, *Link Service Access Point)* is an IrDA connection service endpoint provided by the IrLMP-IAS Information Access Service directory.

SIR *Serial Infrared*, typically at slower speeds (9600 Bd to 115.2 kBd).

SNTP *Simple Network Time Protocol* [RFC-2030], a simplified version of SNTP suitable for 'leaf' devices on a network.

SNMP *Simple Network Management Protocol* [RFC-1157 for SNMPv1; SNMPv3 is the latest version]

TCP/IP *Transmission Control Protocol*, transport protocol that provides reliable, bidirectional, stream service on an IP network.

TinyTP IrDA transport protocol that provides multiple, concurrent, reliable, bidirectional communication streams on an IrDA link with robust flow control.

UTP *Unshielded Twisted Pair*, the type of CAT-5 cabling used in this standard.

9 References

9.1 IEEE 1073.3.2 Transport and Physical Layer (normative)

IEEE 1073.3.2 - 2000 Standard for Medical Device Communications - Transport Profile - IrDA Based - Cable Connected.

An 18-page tutorial is available from the IEEE at:

http://www.ieee-isto.org/mdcig/presentations.html

The complete standard is available for a modest fee at:

http://standards.ieee.org/catalog/olis/meddev.html

9.2 IrDA Standards (normative)

Serial Infrared Physical Layer Link Specification (IrPhys)	v1.2	10nov97
Serial Infrared Link Access Protocol (IrLAP)	v1.1	16jun96
Serial Infrared Link Management Protocol (IrLMP)	v1.1	23jan96
'Tiny TP': A Flow-Control Mechanism for use with IrLMP	v1.1	20oct96

The IrDA standards are available at no charge from the Infrared Data Association at:

http://www.irda.org

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CONNECTIVITY INDUSTRY CONSORTIUM (CIC)

The Universal Standard for Point of Care Connectivity

DEVICE UPPER-LAYER INTERFACE

Device to Data Manager Messaging Draft Specification

CIC Device Team Bi-Directional Working Group
Alan Greenberg and Bob Uleski, Device Team Co-chairs, and
Bryan Allen, Mark Maund, Jeff Perry, Allan Soerensen,
Paul Schluter, Imre Trefil

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TABLE OF CONTENTS

1 CIC Bi-Directional Communication

The purpose of this note is to define the principle elements of a CIC conversation between a Device and a Data Manager and to propose a message flow that can support communicating these elements. The low level protocol will follow the Access Point Specification (CIC DV-AP v02.doc).

1.1 Device Communication Overview

The CIC has identified the following topics for communication between a point-of-care Device and a Data Manager:

- Device Status
- Observations
  - Patient Results
  - Calibration Results
  - Quality Results
    - Liquid QC,
    - Electronic QC,
    - Linearity QC,
    - Calibration Verification,
    - Proficiency Test
- Quality Events
  - Test Denied
  - Uncertified Operator
- Update Lists
  - Certified Operator List
  - Patient List
- Directives
  - Lockout (with explanation)
  - Remove Lockout
- Vendor-specific Data

1.2 The Dialog

The communication between the Device and the Data Manager can be described at a high-level in terms of a dialog between two actors. The following 'script' outlines how this dialog might proceed between a Device (DEV) and a Data Manager (DM):

DEV: Hello DM, I'm device 'xyz'. I'm on-line
DM: Hello 'xyz'. You are a registered device. Please do the following for me…
DM: Device 'xyz', please report your Device Status
DEV: Here is my Device Status. What else would you like me to do?
DM: Device 'xyz', please report your Observations
DEV: Here are my Observations. What else would you like me to do?
DM: Device 'xyz', please report your Quality Events
DEV: Here are my Quality Events. What else would you like me to do?

DM: Device 'xyz', please accept this Directive: 'xxx'

DEV: I have performed Directive 'xxx'. What else would you like me to do?

DM: Device 'xyz', please accept this Vendor-specific Communication: 'yyy'

DEV: I have received Vendor-specific Communication 'yyy'. What else would you like me to do?

DM: Device 'xyz', please terminate this conversation.

DEV: Goodbye, DM.

1.3 Message Flow

The CIC Device Upper Layer Proposal governs the exchange between a point-of-care device (DEV) and a data manager (DM). The following terms are used to describe this exchange:

***Conversation**: A prescribed flow of messages between the DEV and DM, having both an initialization and a termination phase. A Conversation is made up of a series of 'Topics'.*

***Topic:** The flow of messages to exchange a complete set of data within a Conversation (e.g. Observations, QC Events). A Topic is composed of a series of 'Messages'.*

***Message**: The simplest element of data exchange between the DEV and DM. Each Message is composed of one or more 'Segments'*

***Segment**: A Segment is the smallest logical element of a message (e.g. header, payload). Each Segment is composed of one or more 'Field'.*

***Field**: A Field is the smallest element of a message that contains a data element. Examples of fields include 'date', 'observation value', and 'observation units'*

1.3.1 Principles

Many message flows could be constructed to support the dialog described in Section 1.2. The following design principles are used to limit the possible flows.

- The flow should be as simple as possible, but no simpler
  - In general, messaging performance is governed by the number of messages, not the size of the messages.
  - Effort should be made to keep the implementation complexity low (i.e. simplify the DEV and DM state diagrams)
- Although the Device is responsible for initiating the conversation, the Data Manager controls the flow of the conversation.
- An 'Escape' message may be used by either the DEV or DM to 'break out' of a Topic. Control returns to the DM, which must proceed to the next Topic in the Conversation.
- The Data Manager can use the keep alive message to keep the link up with a docked portable device.
- Acknowledgments are used only when needed to convey additional meaning. For example:
  - The Data Manager might acknowledge receipt of information from the Device to indicate to the Device that the Data Manager has assumed responsibility for managing and communicating that information.
  - The Device might send and acknowledgment to the Data Manager to indicate that it is done processing a directive and is ready for another command message.
- The minimal messages present are:
  - Hello
  - Device Status

- Observations
- Good Bye

1.3.2 Idealized Message Flow

The following schematic illustrates a 'perfect' message flow between CIC-compliant devices and data managers. It adheres to the principles described in Section 1.3.2, communicates the elements described in Section 1.1, and follows the dialog expressed in Section 1.2.

Ideal Message Flow

Wednesday, January 03, 2001

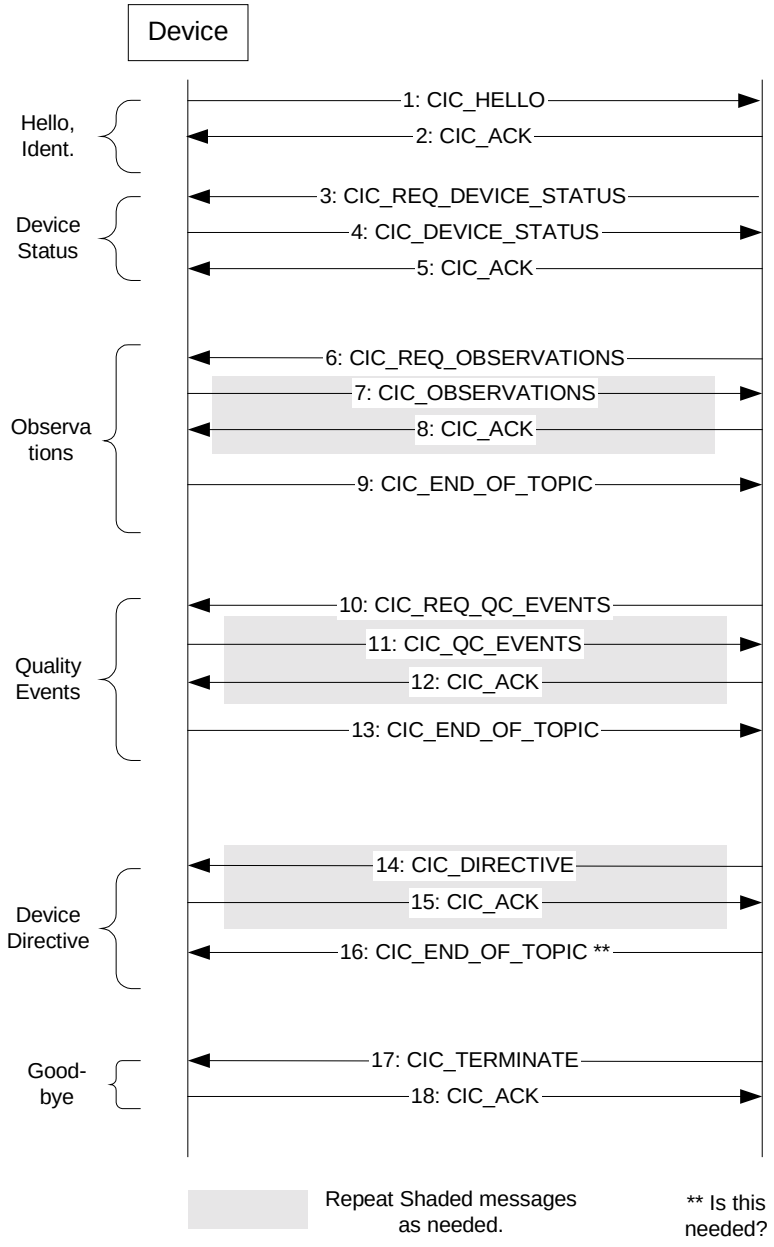

Figure 1: Ideal Device-DM Message Flow

1.3.2.1 Notes on Idealized Message Flow

(1) Only one type of acknowledgement message is illustrated (CIC_ACK). It may be that several different 'species' of ACK are required, however, at this time it is not clear what those might be. Either a CIC_ACK or a CIC_END_OF_TOPIC must be used to end all messages or topics.

(2)The following message types are not illustrated in this flow. They will be defined in forthcoming flows:

- 'Keep Alive' messages
- CIC_ESC messages

(3) The 'grey bar' indicates a recurrent process. In general, this bar substitutes for a repetitive sequence of messages in the form:

CIC_SOMETHING

CIC_ACK

...

The model for termination of this sequence is that once all available 'somethings' have been transferred, the Device responds to the next request with a message containing 'no more somethings'.

(4) A CIC_ACK message could contain several additional attributes:

- A 'percent complete' indication
- A summary of the data that is being acknowledged (e.g. a list of the measurement id's received in an observation upload)

1.3.3 Message flow with an ESC

Either the Device or the Data Manager is allowed to send an 'escape' message (CIC_ESC) at any point in the dialog. This message indicates that the sender is unable to proceed with the current topic of the dialog (e.g. Results, Directives). Upon receipt of a ESC, both the sender and the recipient should proceed to the next state in the dialog. For the Device, this state will be to wait for the next command from the DM. For the DM, this state will be to start the next topic in the dialog.

Escape Message Flow

Friday, January 05, 2001

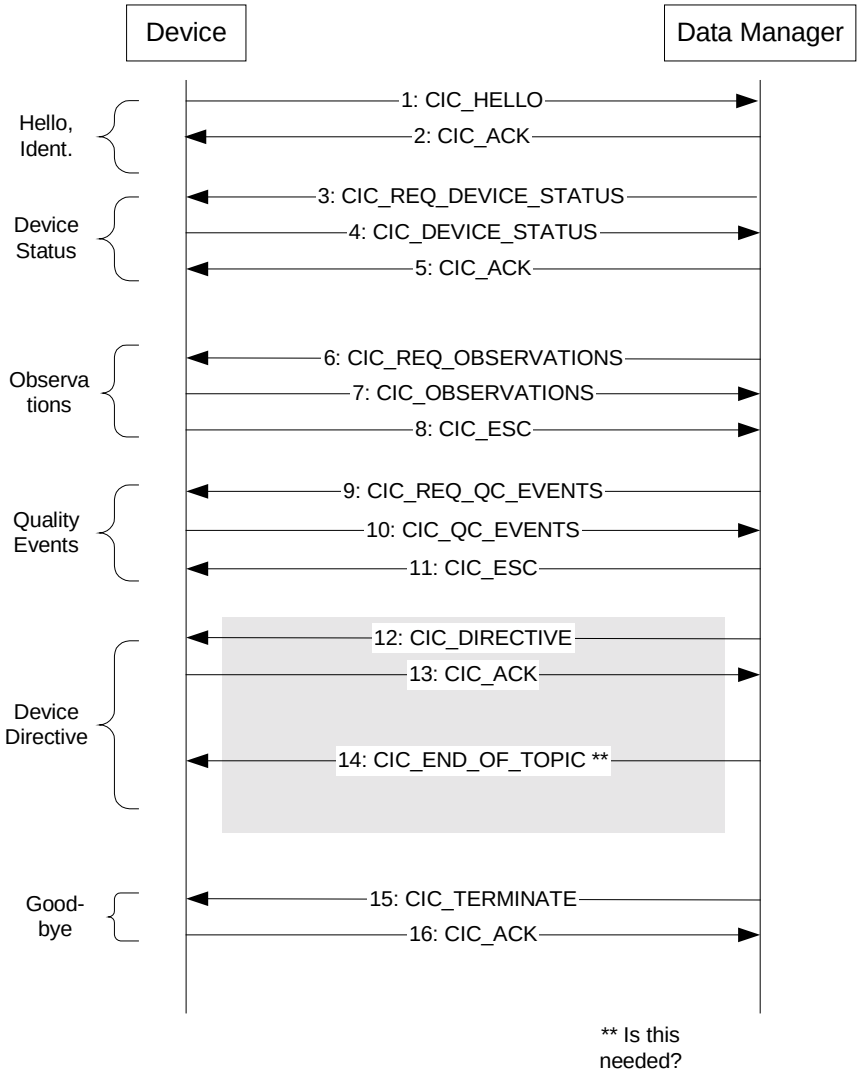

Figure 2: Message Flow with CIC_ESC

1.3.3.1 Notes on ESC Message Flow

- Message 8 illustrates a CIC_ESC from the Device to the DM in response to a failure to respond to the DEVICE_OBSERVATIONS request.
    - o The DM: Upon receiving this CIC_ESC, the DM proceeds on to the next topic of conversation – the exchange of QC Events. If the DM was not satisfied with the prospects for continuing after this Escape, it could also terminate the dialog by sending a CIC_TERMINATE message.

  - The Device: After sending this CIC_ESC, the Device should return to a state waiting for further commands from the DM
- Message 11 illustrates a CIC_ESC from the DM to a Device.
  - The DM: After sending the CIC_ESC, the DM is free to proceed to the next topic in the dialog (message 12, CIC_DIRECTIVE), or to terminate the conversation.
  - The Device: Upon receipt of the CIC_ESC, the Device must assume that it was not able to successfully transmit the QC_EVENTS. It should preserve these events for download at a later session, and proceed to wait for the next command from the DM (message 12, CIC_DIRECTIVE)

The escape message should give a reason. Reasons include:

- Not Supported
- Insufficient memory to store item
- ???

2 Message Structure

The general format for a CIC message is a header segment, followed by a content segment.

2.1 Message Segments

The following sections detail the fields contained in each message segment. The following abbreviations apply to the tables in these sections.

Data Type (DT)

The following definitions are referenced from HL7 v2.3.1, section 2.8.

Data Type	Name	Notes/Format
Alphanumeric		
ST	String	
Numeric		
NM	Numeric	
Date/Time		
DT	Date	YYYY[MM[DD]]
TM	Time	HH[MM[SS[.S[S[S[S]]]]]][+/-ZZZZ]
TS	Time Stamp	YYYY[MM[DD[HHMM[SS[.S[S[S[S]]]]]]]][+/-ZZZZ] ^ <degree of precision>
Identifier		
CE	Coded Element	<identifier (ST)> ^ <text (ST)> ^ <name of coding system (ST)> ^ <alternate identifier (ST)> ^ <alternate text (ST)> ^ <name of alternate coding system (ST)>
ID	Coded value	
IS	User-defined coded value	
HD	Hierarchical Designator	<namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)>

Optionality (OPT)

Abbrv	Meaning	Comment
R	Required	
RE	Required, may be empty	This is an artifact of the HL7 encoding syntax. It may or may not be relevant to CIC messages
O	Optional	
C	Conditional	Conditional on some other field(s). The field definitions should specify the algorithm that defines the conditionality of this field.

2.1.1 Header

The Header segment contains information necessary to route and acknowledge a CIC message

DT	OPT	FIELD NAME	NOTES ON USE
HD	RE	Sending Application	Vendor/Site Specific
HD	RE	Sending Facility	Vendor/Site Specific
HD	RE	Receiving Application	Vendor/Site/ Specific
HD	RE	Receiving Facility	Vendor/Site Specific
TS	R	Date/Time Of Message	CCYYMMDDHHMMSS
ST	R	Message Type	Note (1)
ST	R	Message Control ID	Vendor Specific, Note (2)
ID	R	Version ID	2.3 or higher

(1) Indicates the payload segment to follow (e.g. Observations)

(2) Message Control ID format is vendor specific. Receiver must return the identical Message Control ID in any acknowledgments.

2.1.2 Device Status

This message is used at the initiation of the link to let the Data Manager know what Device it is connected to and the Device's capabilities. There are three main type of status information sent to the DM:

- Device Status – This will include the number of new results, new reagents, the date and time of the last update seen by this device
- Device Identification – The device serial number, S/W version, Make and model of device. This information would be sent separately from other status
- Device Capabilities – Does it support Operator ID lists, partial or full updates only.

DT	OPT	FIELD NAME	NOTES ON USE
ST	RE	CIC Device ID	Note (1)
ST	RE	Vendor Device ID	Note (2)
ST	RE	Manufacturer Name	
ST	RE	Hardware Version	
ST	RE	Software Version	
TS	R	Last Update	Date and time of last sync. Connection
NM	R	New Observations	Range: 0..n
NM	R	New QC Events	Range: 0..n
ST	RE	Device Capabilities	Description of device capabilities. Note (3)

(1) The value of this field is a universally unique string identifying the device. The preferred format for this field is the IEEE RAC format. However, vendor-specific formats and values are allowed.

(2) The value of this field is a vendor-formatted universally unique string identifying the device. For example, the format of this field could be <vendor name>:<model number>:<serial number>.

(3) This field would be used to indicate if the device supported such Topics as Operator Lists, partial updates, etc. The format for this field needs to be defined

2.1.3 Observations (i.e. 'results')

Observations include both the 'results' of analytic tests, as well as several different types of QC testing results. They are:

- Observation Result
- Calibration Results
- Liquid QC,
- Electronic QC,
- Linearity QC,
- Calibration Verification,
- Proficiency Test

The format for the Observation segment is defined as follows:

DT	OPT	FIELD NAME	NOTES ON USE
ST	R	Value Type	Note (1)
CE	R	Observation Identifier	e.g. LOINC code for test
ST	R	Observation Value	e.g. '1.1', 'HI', 'LO'
CE	R	Units	
ST	RE	Abnormal Flags	Documentation use only
TS	R	Date/Time of Observation	
ST	O	Normal Low Limit/High Limit	
ST	O	Critical Low Limit/High Limit	

(1) Possible values: *Observation, Liquid QC, Electronic QC, Linearity QC, Calibration Verification, Proficiency Test*

2.1.4 Quality Events

These messages are used to tell the DM of problems encountered in operation of the DEV. They include:

- Test Denied
- Uncertified Operator

The format for the Quality Event segment is defined as follows:

DT	OPT	FIELD NAME	NOTES ON USE
ST	R	Event Description	Note (1)
TS	R	Date/Time of Event	

(1) Is this for documentation use only, or should we try to standardize these event reports?

2.1.5 Directives

There are several messages considered directives. These messages are used for sending configuation information, lists, and commands from the DM to the DEV. They can also be used for optionally updating the DM with information entered locally at the DEV.

2.1.5.1 CIC_UPDATE_LIST

These messages are used to provide updated information tables to the DEV. They include:

- Certified Operator List
- Patient List

A typical dialog looks like:

DM: Device 'xyz', I know you do not accept incremental updates so please accept this Overwrite 'xxx' of all valid operator IDs for your device type in the location you are with expiration of certifcation dates.

DEV: I have performed Overwrite Directive 'xxx'. What else would you like me to do?

2.1.5.2 CIC_UPDATE_REAGENT_INFO

These messages are used to provide updated Reagent, Control, Calibrator, or Linearity definitions to the DEV.

A typical dialog looks like:

DM: Device 'xyz', I know you do not accept incremental updates so please accept this Overwrite 'xxx' of all valid Reagent definitions for your device type in the location you are with expiration of lot dates.

DEV: I have performed Overwrite Directive 'xxx'. What else would you like me to do?

2.1.5.3 CIC_DEVICE_COMMAND

This message set is used to disable further testing on a DEV until the DM sends a command message. The messages are:

- Lockout (with explanation)
- Remove Lockout
- Start calibration, 1 point
- Standby

A typical dialog looks like:

DM: Device 'xyz', Disable further testing of Glucose with message 'Excessive QC errors on Glucose, See Point of Care Coordinator for corrections'.

DEV: I have performed Disable Directive. What else would you like me to do?

To remove the Lockout:

DM: Device 'xyz', Enable testing of Glucose.

DEV: I have performed Enable testing Directive. What else would you like me to do?

2.1.6 Vendor-specific Data

To send firmware updates, system options that affect workflow such as whether to require an operator ID, … and other device specific information we will signal the device where to go to get the information

At typical dialog will look like:

DM: Device 'xyz', please connect to server 'pdq' and request file update 'zzz.dzz' Vendor-specific Communication: 'yyy'

DEV: I have received Vendor-specific Communication 'yyy'. What else would you like me to do?

2.1.7 Terminate Conversation

To end the conversation either the Data Manager or the Device can initiate the Terminate message at the high level conversation. It is suggested that when the link is terminated the Device should display a user prompt informing the user that the link is terminated and if for an error reason, such as a time-out, the reason should be displayed. Optionally the device may want a confirmation to terminate the link from the user before dropping the link

The format for the Terminate segment is defined as follows:

DT	OPT	FIELD NAME	NOTES ON USE
ST	RE	Event Description	Note (1)

(1) This field allows a description of the Termination event to be communicated. Examples of possible descriptions include 'Normal', 'Unrecoverable Error', 'User Cancelled'.

3 Continuous Connection Message Flow

The continuous connection message flow uses the same conventions and messages as the intermittent connection scenario except that the Device now provides information unsolicited and the Data Manager acknowledges each message. In this mode there is no need for End of Topic or Escape messages from Device or Data Manager. The only communications initiated by the Data Manager are the Keep Alive and Directive messages. *What should the Data Manager do if the first message it receives from an off-line Device is not Hello?*

3.1 Link Start

The first time the device and the DM communicate (after, say a network failure), there could be multiple observations archived by the Device, while it was off-line. After sending a Device Status message (which may contain information about the number of outstanding observations to be communicated), the Device sends the first Observation message and waits for the Data Manager's acknowledgement. If the Data Manager fails to acknowledge any Observation message, the Device will terminate the communication of the archived observations until a real time Observation message is acknowledged – see following section. *How will the acknowledge timeout be defined?*

3.2 Real Time Observations

As soon as the Device has new observations to report, it will send them unsolicited to the Data Manager. If the Data Manager fails to acknowledge the Observation message, the Device will archive the observation data. If the Data Manager acknowledges the Observation message and the Device has archived results, the Device will send a sequence of Observation messages, each time waiting for the Data Manager's acknowledgement before sending the next Observation message.

3.3 Device Status

The Device can send unsolicited Status messages whenever it has new information to convey. If the Data Manager fails to acknowledge a Status message, the Device can ignore the fact and wait until it has new status information before sending the next Status message, or it can try re-sending the message as a keep-alive.

3.4 Keep Alive Messages

If the Data Manager receives no messages within a period of time (e.g. five minutes), it may send a Keep Alive message to the Device, to test whether the Device is still on-line.

If the Device acknowledges the Keep Alive message, then all is well with the link. If an acknowledgement is not received, the Data Manager may terminate the communication with a Terminate message or may continue to send periodic Keep Alive messages (perhaps increasing the frequency).

It might be useful for a Data Manager to obtain current status information from the device. Rather than introduce a Request Device Status message, the Device could always follow its acknowledgement of a Keep Alive message with the transmission of a Device Status message.

If the Device wants to test the on-line status of the Data Manager, it will send a Device Status message and look for the Data Manager's acknowledgement.

3.5 Directive Messages

The Data Manager can send a Directive message at any time. The Device will acknowledge the message and will convey the consequences of the action in a follow-up Device Status message.

Could the acknowledgement indicate whether the Device will take action on the directive and if not, why not?

The transmission of Keep Alive and Directive messages by the Data Manager are asynchronous to whatever the Device may be doing. For these messages, the Device is expected to respond with an acknowledgement and potentially (in the case of a Directive) a Device Status message, even while it is working through a long list of Observation messages.

3.6 Terminate Messages

By the continuous nature of this connection, neither the Device nor the Data Manager is expected to transmit a Terminate message, except potentially when the Device fails to Acknowledge a Keep Alive message.

If the network goes down and comes back up before the device has learnt that the Data Manager is no longer there (through lack of a message acknowledgement), how can the Data Manager re-start the connection?

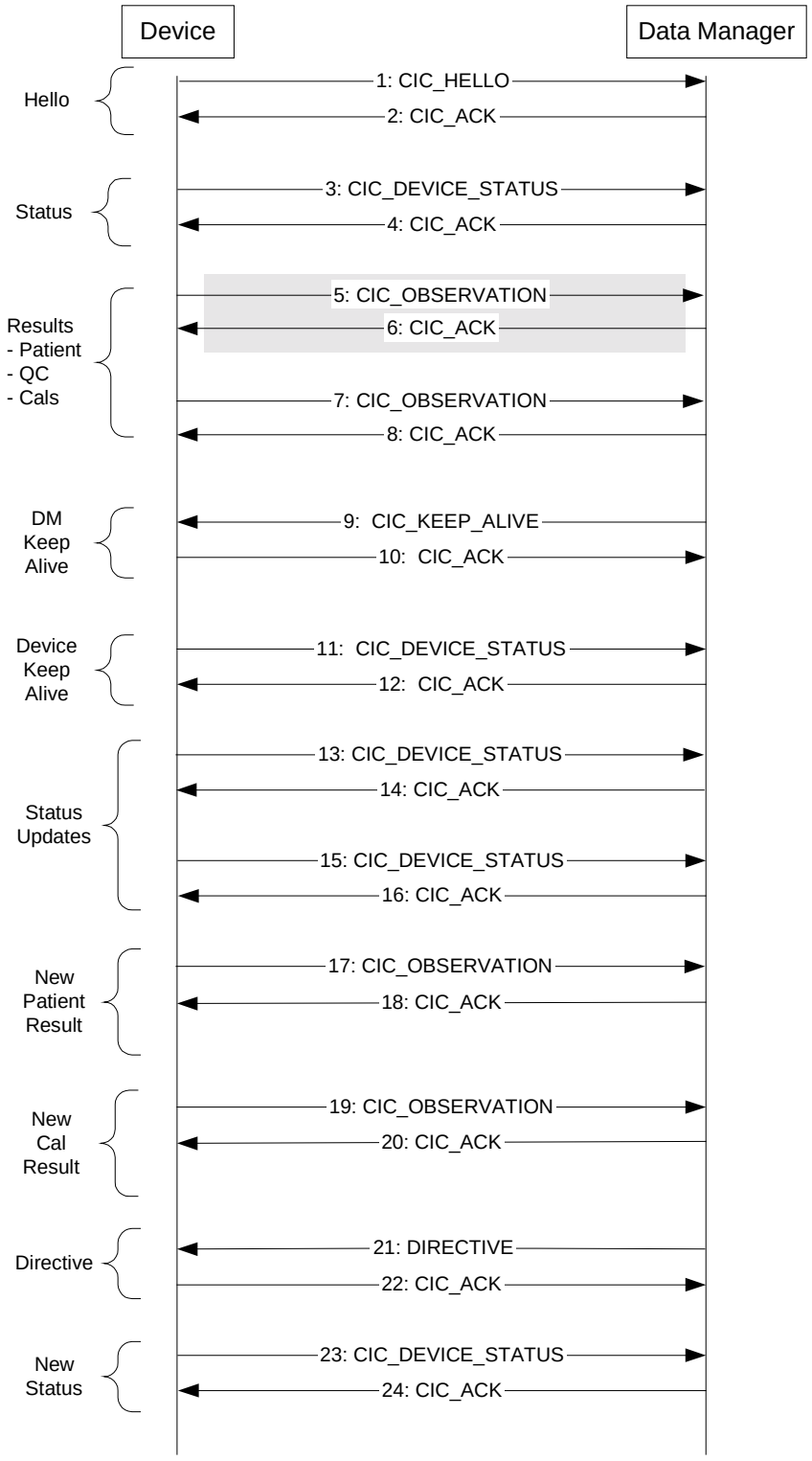

Figure 3: Continuous Message Flow

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CONNECTIVITY INDUSTRY CONSORTIUM (CIC)

The Universal Standard for Point of Care Connectivity

OBSERVATION REPORTING INTERFACE

HL7 Draft Specification

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TABLE OF CONTENTS

1 Document Scope

The EDI Interface defined in this document governs the communication between the Observation Reviewer and the Observation Recipient (e.g. LIS or HIS) in the CIC Architecture.

2 Use Case Descriptions

The use cases here are divided between single valued results and multi-valued results including Blood Gas Results. In addition the use cases are divided up between reporting results that are preordered and results for which an order does not exist. Preordered and Unordered cases are distinguished by the Order Control code in the ORC-1 field; RE for pre-ordered and NW for unordered tests.

2.1 Use Case #1: Preordered Test with Single Valued Result

This use case concerns the Patient Test Result Transfer from a generic single-measurement device (such as a SureStep Pro or Roche GTS/HQ) where the test is performed by a Nurse or Med Tech at or near bedside on a patient identified by Patient ID. The Test is considered to have been already been ordered under "standing orders" or other hospital protocols and is identified to the device by Accession Number/Order ID.

When possible the Patient ID must also be provided to the device.

The device will communicate to the LIS via an Observation Reviewer, which will support the EDI protocol. Optional to this use case are Patient ID, the Patient Account Number, and Ordering Physician ID when required by the LIS.

2.2 Use Case #2: Unordered Test with Single Valued Result

This use case concerns a Patient Test Order and Result Transfer from a generic single-valued device (such as a SureStep Pro or Roche GTS/HQ) where the test has not already been ordered. The automatic ordering of the test is allowed:

(1) under "standing orders" for the Patient, or

(2) under "as needed orders" for the Patient, or

(3) as a result of a request from a physician or notification by another means (e.g. message from the HIS) that the test is to be performed at a specified time.

A Nurse or Med Tech performs the test at or near bedside on a patient who is identified to the device by Patient ID.

The device will communicate to the LIS via an Observation Reviewer that will support the EDI protocol. Under this case, the Observation Reviewer will place an Order for the test into the LIS/HIS and will immediately Result the test in the same message.

2.3 Use Case #3: Unordered Test with Multi-valued Result

Patient Test Order and Result Transfer from a generic multi-valued device (such a CliniTek) where the test has not already been ordered. Automatic ordering of the test is allowed under the rules specified for the previous use case.

The device will communicate to the LIS via an Observation Reviewer which will support the EDI protocol. Under this case, the Observation Reviewer will place an Order for the "profile" or "package"

of tests into the LIS/HIS and will immediately Result the test in the same message using individual Observation Results segments for each value.

2.4 Use Case #4: Unordered Blood Gas Result

The Patient Test Order and Result Transfer from a Blood-Gas analyzer where the test has not already been ordered. Automatic ordering of the test is considered to be allowed under the rules specified for the previous use case This use case illustrates:

(1) the content of results from a typical Blood Gas Analyzer.

(2) how multi-valued results are identified via a single service id (battery or panel).

(3) how the specimen source is identified.

(4) Extra attribution by the Observation Reviewer. Add abnormal flags to each result after analyzing the values with respect to accepted normal and critical ranges. The result is reviewed and approved at the Data management system.

(5) The Set ID field is used as a sequence number that is counted up for each OBX segment sent. Allows retransmission of OBX segments should a checksum error occur during transmission.

Automatic ordering of the test is allowed under the rules specified for use case #2.

The device will communicate to the LIS via an Observation Reviewer, which will support the EDI protocol. Under this case, the Observation Reviewer will place an Order for the “profile” or “package” of tests into the LIS/HIS and will immediately Result the test in the same message using individual Observation Results segments for each value.

3 Message Profile

Class	Attribute	Min. Card	Max. Card	Coding Stand.	Comments	Seg. Used
Device		**1**	**1**			
	Identifier(1)	1	1	IEEE	Device Type / Serial number / GUID - could be the name of a manual test. E.g. Roche HQ^777777	OBX-15
Operator		**1**	**1**			
	Identifier	1	1		Could be empty. Though desired in the US, it is not in other countries (see note 6)	OBX-16
Patient		**1**	**1**			
	Identifier	1	1		Use Cases #2, #3 #4. Use Case #1 requires Patient ID, if available, else the Accession Number/Order ID, (see note 6)	PID-3
	Account Number (see note 9)	1	1		Use Cases #2, #3 #4. May be required at some sites to uniquely identify visit along with Patient ID.	PID-18
Specimen		**1**	**1**			
	Identifier	1	1		Use case #1. Accession number, Order ID or similar	OBR-2
	Role	1	1		Identifies patient, control, linearity, etc.	
	Type	1	1		Use case #4. Identifies sample – venous, capillary, etc.	OBR-15
Observation		**1**	**1**			
	Analysis Date & Time (see note 3)	1	1	HL7	CCYYMMMDDHHMMSS plus optional time zone information (see note 7)	OBX-14
	Comments (see note 4)	1	1		Describes conditions, events or circumstances that may need to be considered when using the observation. Up to 3 comments may be associated with a single NTE segment by using the ¨ repeat separator in NTE-3 field.	NTE-3 - follows OBR segment
Order		**1**	**1**			
	Service Identifier	1	1	LOINC or custom	LOINC code^mnemonic. Mnemonic may be standard or locally defined. Package/Profile/Panel names may be locally defined. Where multiple parameters / sample demographics are to be reported, they should all be concatenated into the one package/profile identifier.	OBR-4
	Ordering Physician (see note 9)	1	1		Use Cases #2, #3, #4. May be required at some sites to Order test. E.g. 12345^Smith^John^J^Dr	OBR-16
		1	*****			

Class	Attribute	Min. Card	Max. Card	Coding Stand.	Comments	Seg. Used
		1	*			
	Value Identifier	0	1	LOINC or custom	LOINC code mnemonic used as the primary coding system. Mnemonic may be standard or locally defined. E.g. 1234-5^GLU^LN For observations that cannot be identified by a LOINC code the alternate coding system components of OBX-3 can be used to identify the observation. E.g. 1234^AADD2^L&E (in this case a mnemonic identifying the parameter along with a sub-component specifying the type of observation in this case Estimated)	OBX-3
	Non-specific value	0	1		Examples: "150", "< 50", "> 550" If not provided the Non-specific value is used (OBX-8) to specify the observation value May be used in lieu of Value Example: "N" for Normal. For results where numeric values are provided in OBX-5 may be used to further specify the normalcy/abnormalcy of the numeric value. HL7 2.3.2 8.	OBX-8
	Units	1	1		Units of measurement. HL7 7.3.2.6 and table 7.18.4	OBX-6
	Value Flag	0	1		Any flags or alarms associated with result. Temp error, expired strip, etc.	NTE-3 - follows related OBX segment

3.1 Notes:

#	Date	Who	Note
1	6/8/00	Device Team	• Identifier should be globally unique. IEEE format consists of IEEE-assigned organization id field, followed by organization-assigned id.
2	6/8/00	Device Team	• Order group deleted, and Identifier moved to Specimen object, as the accession number is related to the specimen.
3	6/8/00	EDI	• One-second resolution was felt to be adequate for POCT result reports.
4	4/8/00	Rick Lebo	• Refer to Rick Lebo's comment field use case document
5	6/15	Device Team	• Range reporting struck. Rational: Reference and Critical range not likely known by device, and Measurement Range is only useful internally: e.g. to format the Value field ('<50')
6	6/15	Device Team	• Most devices can record, at most, one patient identifier – usually either patient, account number, or accession number • The identifier values for Operator may be left blank, if unknown/unspecified. Accession Number/Order ID should be used for Patient ID if otherwise unavailable. If insufficient information is supplied to the Result Observer, an exception should be generated.
7	6/15	EDI Team	• Time zone qualification of the date/time is optional. If the time zone is omitted from the message, the time is assumed to be 'local time' (where

#	Date	Who	Note
			the device is located).
8	9/13	EDI Team	• Reworked to merge three Use Cases • Reworked XML encoding • Formatted for 8.5 x 11 document
9	10/9	EDI Team	• Field is optional. May be required at some sites.

4 HL7 Message Definition

The following sections describe how to implement the Message Profile describe above, using either the HL7v2.x ER syntax or the XML encoding.

4.1 HL7 v2.3.1 Abstract Message Definition

The Abstract Message Syntax in HL7 v2.3.1 specifies the arrangement of segments within a message. The simple glucose test result message's structure is defined using this syntax as follows:

	Point-of-Care Observation
MSH	Message Header
PID	Patient Identification
ORC	Common Order information
OBR	Observation Request
[NTE]	Notes or Comments for order/result, zero or one per message
{	
OBX	Observation Results, one per reported value
[NTE]	Notes or Comments for individual result, zero or one per reported value
}	

The brackets and braces have the following meaning:

HL7 ABSTRACT MESSAGE SYNTAX	**OCCURRENCE**
[]	Zero or one
{}	One or more
{[]} = [{}]	Zero or more
- no bracket or brace -	One exactly

4.1.1 MSH – Message Header Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	NOTES ON CIC USE
1	1	ST	R	Field Separator	"|" unless otherwise required
2	4	ST	R	Encoding Characters	"^~\&" unless otherwise required
3	180	HD	RE	Sending Application	Vendor/Site Specific
4	180	HD	RE	Sending Facility	Vendor/Site Specific
5	180	HD	RE	Receiving Application	Vendor/Site/ Specific
6	180	HD	RE	Receiving Facility	Vendor/Site Specific
7	26	TS	R	Date/Time Of Message	CCYYMMDDHHMMSS
8	40	ST	X	Security	
9	7	CM	R	Message Type	ORU^R01, ORM^O01, ACK^R01, ACK Note (1)
10	20	ST	R	Message Control ID	Vendor Specific, Note (2)
11	3	PT	R	Processing ID	"T"/"D"/"P" (Training, Debug, Production)
12	8	ID	R	Version ID	2.3.1
13	15	NM	X	Sequence Number	
14	180	ST	X	Continuation Pointer	
15	2	ID	R	Accept Acknowledgment Type	"AL" Note (3)
16	2	ID	R	Application Acknowledgment Type	"AL", "NE" Note (4)
17	2	ID	RE	Country Code	Empty for USA

Any fields defined beyond Sequence 17 are ignored by this specification.

(1) ORU^R01 for Result without Order,
ORM^O01 for Result with Order
ACK^R01 for Application acknowledgment to ORU^R01
ORR^O02 for Application acknowledgment to ORM^O01
ACK for all Accept/Commit Level acknowledgments

(2) Message Control ID format is vendor specific. Receiver must be prepared to accept at least 32 characters and must return the identical Message Control ID in MSA-2 for both Accept/Commit Level and Application Level acknowledgments.

(3) All source messages (ORU, ACK^R01, etc.) should specify "AL" - Always Accept/Commit Acknowledge. Accept/Commit Acknowledgments (ACK) should specify "NE"

(4) For Original Acknowledge Mode: all Order/Result messages (ORU, ORM) will specify "NE" - Never Application Acknowledge.
For Enhanced Acknowledge Mode: all Order/Result messages (ORU, ORM) will specify "AL" – Always Application Acknowledge.
All Acknowledgment Messages (ACK) must specify "NE" – Never Application Acknowledge.

4.1.2 MSA – General Acknowledgment Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	DESCRIPTION and CIC USE
1	2	ID	R	Acknowledgment Code	"CA", "CE", "CR", "AA", "AE", "AR", Note (1)
2	20	ST	R	Message Control ID	From MSH-10 of associated message
3	80	ST	RE	Text Message	Note (2)
4	15	NM	X	Expected Sequence Number	
5	1	ID	X	Delayed Acknowledgment Type	
6	100	CE	RE	Error Condition	Error Code, Note (3)

Any fields defined beyond Sequence 6 will be ignored by this specification.

(1) "CA", "CE", "CR" Accept/Commit Level Acknowledge, Error, or Rejected.
"AA", "AE", "AR" Application Level Acknowledge, Error, or Rejected.
'Use of CE vs. CR and AE vs. AR is vendor /site specific.

(2) "CA" – Should be empty
"AA" – Order Message Acknowledgments must specify Accession Number/Order ID, or other database "key" for order and result.
"CE", "CR", "AE", "AR" – Must specify detailed error message

(3) Error Code corresponding to MSA-3, if any.

4.1.3 PID– Patient Identification Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	NOTES ON CIC USE
1	4	SI	O	Set ID - Patient ID	Optional. SetId Sequence Number
2	20	CX	X	Patient ID (External ID)	
3	20	CX	R	Patient ID (Internal ID)	Case #1: Patient ID, if available, otherwise Accession Number/ Order ID Case #2, #3, #4 Patient ID. Note (1)
4	20	CX	X	Alternate Patient ID – PID	
5	48	XPN	X	Patient Name	
6	48	XPN	X	Mother's Maiden Name	
7	26	TS	X	Date/Time of Birth	
8	1	IS	X	Sex	
9	48	XPN	X	Patient Alias	
10	1	IS	X	Race	
11	106	XAD	X	Patient Address	
12	4	IS	RE	Country Code	Empty for USA
13	40	XTN	X	Phone Number – Home	
14	40	XTN	X	Phone Number – Business	
15	60	CE	X	Primary Language	
16	1	IS	X	Marital Status	
17	3	IS	X	Religion	
18	20	CX	C	Patient Account Number	Case #2, #3, #4 as required. Note(2)
19	16	ST	X	SSN Number – Patient	

Any fields defined beyond Sequence 18 will be ignored for this test case.

(1) The Patient ID must be supplied as the value entered into the POC device which identifies the Patient. This may be a Medical Record Number or Account Number or may be the Accession Number or Order ID of the test. In the event that this is identical to the number to the Patient Account Number, both this field and PID-18 should be provided.

(2) Account Number may be required to identify visit at some facilities.

4.1.4 ORC– Common Order Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	NOTES ON CIC USE
1	2	ID	R	Order Control	Case #1: "RE" Case #2, #3, #4: "NW". Note (1)
2	22	EI	X	Placer Order Number	
3	22	EI	X	Filler Order Number	
4	22	EI	X	Placer Group Number	
5	2	ID	X	Order Status	
6	1	ID	X	Response Flag	
7	200	TQ	X	Quantity/Timing	
8	200	CM	X	Parent	
9	26	TS	X	Date/Time of Transaction	
10	120	XCN	X	Entered By	
11	120	XCN	X	Verified By	
12	120	XCN	X	Ordering Provider	
13	80	PL	X	Enterer's Location	
14	40	XTN	X	Call Back Phone Number	
15	26	TS	X	Order Effective Date/Time	
16	200	CE	X	Order Control Code Reason	
17	60	CE	X	Entering Organization	
18	60	CE	X	Entering Device	

Any fields defined beyond Sequence 1 will be ignored for this test case.

(1) "NW" – New Order for ORM^O01. "RE" – Observations Follow for ORU^R01

NOTE: Some fields specified for ORC duplicate fields in the OBR or OBX. HL7 encourages the use of ORC for such values; however, to provide backward compatibility with some vendors who currently do not process the ORC segment, this information is also allowed to be specified in the OBR and OBX.

4.1.5 OBR – Observation Request Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	NOTES ON CIC USE
1	4	SI	O	Set ID – OBR	Optional. SetId Sequence Number
2	75	EI	R	Placer Order Number	Case #1 Only: Accession Number/Order ID
3	75	EI	X	Filler Order Number	
4	200	CE	R	Universal Service ID	e.g. 1-2345^GLU^LN for single valued result. Note (3)
5	2	ID	X	Priority	
6	26	TS	X	Requested Date/time	
7	26	TS	X	Observation Date/Time	
8	26	TS	X	Observation End Date/Time	
9	20	CQ	X	Collection Volume	
10	60	XCN	X	Collector Identifier	
11	1	ID	R	Specimen Action Code	"O" (Specimen obtained by service other than Lab)
12	60	CE	X	Danger Code	
13	300	ST	X	Relevant Clinical Info.	
14	26	TS	X	Specimen Received Date/Time	
15	300	CM	X	Specimen Source	Case #4: e.g. BLDA^^^LLFA (Arterial blood taken from left lower forearm) Note (2)
16	80	XCN	C	Ordering Provider	Case #2, #3, #4: e.g. Smith^John^J^Dr, Note (1)
17	40	XTN	X	Order Callback Phone Number	
18	60	ST	C	Placer field 1	Case #4:Identifier assigned by DMS or POC device to identify Observation
19	60	ST	X	Placer field 2	
20	60	ST	X	Filler Field 1	
21	60	ST	X	Filler Field 2	
22	26	TS	X	Results Rpt/Status Chng – Date/Time	
23	40	CM	X	Charge to Practice	
24	10	ID	X	Diagnostic Serv Sect ID	
25	1	ID	X	Result Status	
26	400	CM	X	Parent Result	
27	200	TQ	X	Quantity/Timing	
28	150	XCN	X	Result Copies To	
29	150	CM	X	Parent	
30	20	ID	X	Transportation Mode	
31	300	CE	X	Reason for Study	
32	200	CM	X	Principal Result Interpreter	
33	200	CM	X	Assistant Result Interpreter	
34	200	CM	X	Technician	
35	200	CM	X	Transcriptionist	
36	26	TS	X	Scheduled Date/Time	

Any fields defined beyond Sequence 16 will be ignored for this test case.

(1) Ordering Provider or Responsible Physician may be required at some sites to place an Order. Optional elsewhere.

(2) Specimen source is a 4 component field. For the CIC protocol only the first (specimen type taken from HL7 Table 0070) and optionally 4th component (from HL7 Table 0163) are specified. Use of other fields is vendor/site specific.

(3) Universal service id is identical to the Service id in the OBX segment for single valued result. For multi-valued results this will identify a Package/Profile/Panel name that is vendor/site specific (e.g. BG-OXI-ELECT for a panel that is to include Blood-Gas, Oximetry (Hemoglobin and derivatives) and electrolytes).

4.1.6 OBX – Observation Result Segment

SEQ	LEN	DT	OPT	HL7 SEGMENT FIELD NAME	NOTES ON CIC USE
1	10	SI	O	Set ID - OBX	Optional. SetId Sequence Number
2	2	ID	R	Value Type	CIC values "ST" (string)
3	590	CE	R	Observation Identifier	e.g 1234-5^GLU^LN
4	20	ST	X	Observation Sub-ID	
5	65536	*	CE	Observation Value	E.g. "150", "<50", "HI", "LO" , Note (1)
6	60	CE	RE	Units	"mg/dl" or similar, Note (2), see HL7 7.3.2.6
7	10	ST	X	References Range	
8	40	ID	RE	Abnormal Flags	HL7 7.3.2.8 Note (3) Note (4)
9	5	NM	X	Probability	
10	2	ID	X	Nature of Abnormal Test	
11	1	ID	R	Observ Result Status	"F" (final result)
12	26	TS	X	Date Last Obs Normal Values	
13	20	ST	X	User Defined Access Checks	
14	26	TS	CE	Date/Time of the Observation	CCYYMMDDHHMMSS from the device Note (5)
15	60	CE	CE	Producer's ID	Instrument Name^Serial Number Note (5)
16	80	XCN	CE	Responsible Observer	POC User ID^optional Last^First name Note (5)
17	60	CE	X	Observation Method	

Any fields defined beyond Sequence 16 will be ignored for this test case.

(1) Some devices can record "HI" or "LO" or similar as the result value when beyond the range of the instrument. In addition, some sites wish to have values outside site defined ranges to be specified in the form "< 50" or ">550". The Reporter may also convert these values to some reference range limit at the Hospital's request. This field may be empty if OBX-8 is used.

(2) May be empty if no units apply, e.g. pH.

(3) This field may be used, in lieu of OBX-5, to indicate a relative result such as High (H), Low (L), or Normal (N). See HL7 Table 0078 for more relative codes.

(4) Care must be exercised when providing Reference Range or Abnormal Flag Values in an Recipient transfer. Should these values be used by nursing or other personnel to adjust their treatment plan, it might well bring the interface under FDA regulation or open the interface vendor to possibility legal liabilities. While some sites may require such support, their wide spread use is discouraged by this standard.

(5) For multi-valued results from the same device this field is only required in the first OBX segment.

4.1.7 NTE – Notes And Comments Segment

SEQ	LEN	DT	OPT	ELEMENT NAME	
1	4	SI	X	Set ID - NTE	
2	8	ID	X	Source of Comment	application specific
3	64k	FT	RE	Comment	Comment 1~Comment 2~Comment 3

5 Sample Messages

5.1 General Notes

In the following examples the Point of Care device, Observation Reporter and Observation Reviewer are identified using generic CIC system names:

Role	System name	Example
Observation Reporter Facility	CICDMS-OBSREP	RALS-LIS
Observation Reporter Application	CICDMS	RALS
Observation Reviewer Facility	CICLIS-OBSREV	SQ or Sunquest
Observation Reviewer Application	CICLIS	Flexilab
Single-analyte POC device	CICDEV-SINGRES^111	Lifescan Surestep^77777
BG Multi-analyte POC analyzer	CICDEV-MULTRES^222	Radiometer ABL735

5.2 Values for Sample Messages

The generic single valued device will provide the following information:

- Device Identifier (globally unique identifier – IEEE format -- preferred)
- User ID (“9876”)
- Patient ID of the Patient, (MR# “12345678”, Facility 1), may not be available for this test case
- ID of the ordered test (“A24680”)
- Test Date and Time (06/09/2000 10:21:35 AM)
- Comment Codes or Text (“Stat”, and “Physician Notified”)
- Service ID (“1234-5^GLU^LN” for Glucose)
- Test Result in mg/dl (105 mg/dl)
- Value Flag (empty)
- Account Number, (“135792468”), required at some sites, is shown here for completeness.
- Ordering Physician, (“Dr. John J. Smith”), required at some sites to order, is shown here for completeness.

5.3 Sample Message Exchanges (ER Encoding)

Note: In the following samples the designations <VT>, <CR>, and <FS> represent the ASCII characters 11, 13, and 28 and not literal strings. Individual segments are placed on separate lines for readability; this does not imply the presence of a <CR>, <LF>, or other end of line designation unless explicitly expressed.

5.3.1 Use Case #1, Preordered Test with Single Valued Result

ORU^R01 Observation Result Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<VT>
MSH|^~\&|CICDMS|OBSREP|CICLIS|OBSREV|20000610010355||ORU^R01|20000610010355:023|P|2.3.1|||AL|AL<CR>
PID|||12345678^^^1||||||||||||||135792468^^^1<CR>
ORC|RE<CR>
```



```
OBR||A24680||1234-5^GLU^LN|||||||O|||||5555^Smith^John^J^Dr<CR>
OBX||ST|1234-5^GLU^LN||120|mg/dl|||||F|||20000609102135|CICDEV-SINGRES^111|9876<CR>
NTE|||Stat~Physician Notified<CR>
<FS><CR>
```

CICLIS must reply immediately with either a Commit ACK specifying CA, CE, or CR. CICLIS generates its own Message Control ID and uses the Message Control ID field from the received message for MSA;2. For success:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010356||ACK|20000610010356CA|P|2.3.1|||NE|NE<CR>
MSA|CA|20000610010355:023<CR>
<FS><CR>
```

Otherwise, for a Commit error:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010356||ACK|20000610010356CE|P|2.3.1|||NE|NE<CR>
MSA|CE|20000610010355:023|TCP Comm Error, Invalid HL7 Message|||3214<CR>
<FS><CR>
```

If CICLIS is unable to accept both the order AND the result, no order should be placed!

If this were Original Acknowledgment Mode (as may be specified in ORU Message MSH-16, this would be the end of the transfer communication.

For Enhanced Acknowledge Mode, the following exchanges apply:

Later, the LIS must send an ACK message as an Application Acknowledgment. This message is created similar to the Commit Acknowledgment except that the Message Type is ACK^R01 rather than ACK and the ACK code is AA, AE, or AR.

For success:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010400||ACK^R01|20000610010400AA|P|2.3.1|||AL|NE<CR>
MSA|AA|20000610010355:023<CR>
<FS><CR>
```

Otherwise, for an error:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010401||ACK^R01|20000610010400AE|P|2.3.1|||AL|NE<CR>
MSA|AE|20000610010355:023|Invalid Patient ID|||5634<CR>
<FS><CR>
```

If CICLIS is unable to accept both the order AND the result, no order should be placed!

Finally, CICDMS-OBSREP will send a Communication Level ACK message for the LIS ACK Message:

```
<VT>
MSH|^~\&|CICDMS|OBSREP|CICLIS|OBSREV|20000502010401||ACK|20000610010401CA|P|2.3.1|||NE|NE<CR>
```


MSA|CA|20000610010400AA<CR>
<FS><CR>

5.3.2 Use Case #2, Unordered Test with Single Valued Result

ORM^O01 General Order Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<VT>
MSH|^~\&|CICDMS|OBSREP|CICLIS|OBSREV|20000610010355||ORM^O01|20000610010355:023|P|2.3.1|||AL|AL<CR>
PID|||12345678^^^1|||||||||||||135792468^^^1<CR>
ORC|NW<CR>
OBR||||1234-5^GLU^LN|||||||O|||||5555^Smith^John^J^Dr<CR>
OBX||ST|1234-5^GLU^LN||120|mg/dl|||||F|||20000609102135|CICDEV-SINGRES^111|9876<CR>
NTE|||Stat~Physician Notified<CR>
<FS><CR>
```

CICLIS must reply immediately with either a Commit ACK specifying CA, CE, or CR. CICLIS generates its own Message Control ID and uses the Message Control ID field from the received message for MSA;2. This reply is identical to that given in Use Case #1.

If CICLIS is unable to accept both the order AND the result, no order should be placed!

If this were Original Acknowledgment Mode (as may be specified in ORM Message MSH-16, this would be the end of the transfer communication.

For Enhanced Acknowledge Mode, the following exchanges apply:

Later, the LIS must send an ORR message as an Application Acknowledgment. This message is created similar to the Commit Acknowledgment except that the Message Type is ORR^O01 rather than ACK and the ACK code is AA, AE, or AR. This message will also return either the Accession Number/Order ID of the ordered test or an application level Error description.

For success:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010400||ORR^O02|20000610010400AA|P|2.3.1|||AL|NE<CR>
MSA|AA|20000610010355:023| A24680<CR>
<FS><CR>
```

Otherwise, for an error:

```
<VT>
MSH|^~\&|CICLIS|OBSREV|CICDMS|OBSREP|20000610010401||ORR^O02|20000610010400AE|P|2.3.1|||AL|NE<CR>
MSA|AE|20000610010355:023|Invalid Patient ID|||5634<CR>
<FS><CR>
```

If CICLIS is unable to accept both the order AND the result, no order should be placed!

Finally, CICDMS-OBSREP will send a Communication Level ACK message for the LIS ACK Message. This Message is identical to that given in Use Case #1.

5.3.3 Use Case #3, Unordered Test with Multi-Valued Result

ORM^O01 Observation Result Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<VT>
MSH|^~\&|CICDMS|OBSREP|CICLIS|OBSREV|20000610010355||ORM^OO1|20000610010355:023|P|2.3.1|||AL|AL<CR>
PID|||12345678^^^1|||||||||||||135792468^^^1<CR>
ORC|NW<CR>
OBR||||Urine Panel 2|||||||O|||||5555^Smith^John^J^Dr<CR>
OBX||ST|L5678^pH||5.2|||||F|||20000609102135|CICDEV-SINGRES^111|9876<CR>
OBX||ST|L2412^Ketone|||||N|||F|||20000609102135|CICDEV-SINGRES^111|9876<CR>
<FS><CR>
```

CICLIS replies and CICDMS-OBSREP CA acknowledgments are all identical to Use Case #2.

If an error occurs which is associated with only one device value, the offending value should be identified in the MSA error field in the ACK or ORR message returned by CICLIS.

If CICLIS is unable to accept both orders and both results, no order should be placed nor any value accepted. This allows the send to retransmit the entire message, with possible modifications, at a later time without order duplication.

5.3.4 Use Case #4 Unordered Test with Blood Gas Multi-Valued Result

ORM^O01 Observation Result Message From CIC-OBSREP to CIC-OBSREV LIS sent 6/10/00 1:03:55

```
MSH|^~\&|CICDMS|OBSREP|CICLIS|OBSREV|20000610010355||ORM^O01|20000610010355:023|P|2.3.1|||AL|AL<CR>
PID|1||12345678^^^1||Smith^John|||M|||||||||135792468^^^1<CR>
ORC|NW<CR>
OBR|1|||BG-OXI-ELECT|||||||O||||BLDA^^^LLFA|5555^Smith^John^J^Dr||8024^Sample #<CR>
NTE|1||Battery approved by JAG~Dr. G. John notified of result<CR>
OBX|1|ST|2703-7^^LN^pO2&M||110|mmHg||H|||F|||20000609102135|CICDEV-MULTRES^222|9876<CR>
NTE|1||Stat~Measured value above reference range but within the critical limits<CR>
OBX|2|ST|11557-6^^LN^pCO2&M||33.2|mmHg||L|||F<CR>
NTE|1||Stat~Measured value below reference range but within the critical limits<CR>
OBX|3|ST|11558-4^pH^LN^pH&M||7.474|||H|||F<CR>
NTE|1||Stat~Measured value above reference range but within the critical limits<CR>
OBX|4|ST|6298-4^POTASSIUM^LN^K+&M||3.7|mmol/L||N|||F<CR>
OBX|5|ST|14775-1^HEMOGLOBIN^LN^tHb&M||11.6|g/dL||N|||F<CR>
OBX|6|ST|4536-9^DEOXYHEMOGLOBIN/HEMOGLOBIN.TOTAL^LN^RHb&M||1.3|%||N|||F<CR>
OBX|7|ST|^^^O2Hb&M||96.9|%||N|||F<CR>
OBX|8|ST|20563-3^CARBON MONOXIDE.HEMOGLOBIN^LN^COHb&M||1.2|%||N|||F<CR>
OBX|9|ST|2614-6^METHEMOGLOBIN/HEMOGLOBIN.TOTAL^LN^MetHb&M||0.6|%||N|||F<CR>
OBX|10|ST|20092-3^BODY TEMPERATURE^LN^T&I||35.3|Cel|||||F<CR>
OBX|11|ST|19994-3^^LN^FIO2&I||30.0|%|||||F<CR>
OBX|12|ST|^^^pH(T)&C||7.500||||||F<CR>
OBX|13|ST|^^^pCO2(T)&C||30.5|mmHg|||||F<CR>
```



```
OBX|14|ST|19235-1^^LN^SBE&C||0.8|mmol/L|||||F<CR>
OBX|15|ST|19230-2^^LN^SBC&C||25.6|mmol/L|||||F<CR>
OBX|16|ST|20570-8^^LN^Hct&C||35.7|%|||||F<CR>
OBX|17|ST|19254-2^^LN^pO2(T)&C||101|mmHg|||||F<CR>
OBX|18|ST|19214-6^^LN^p50(act)&E||24.15|mmHg|||||F<CR>
OBX|19|ST|^^^AaDpO2&E||59.1|mmHg|||||F<CR>
OBX|20|ST|^^^AaDpO2,T&E||72.0|mmHg|||||F<CR>
OBX|21|ST|^^^tO2&C||15.9|Vol%|||||F<CR>
OBX|22|ST|^^^RI&E||54|%|||||F<CR>
```

CICLIS replies and CICDMS-OBSREP CA acknowledgments are all identical to Use Case #2.

If an error occurs which is associated with only one device value, the offending value should be identified in the MSA error field in the ACK or ORR message returned by CICLIS.

If CICLIS is unable to the orders and all the results documented in the OBX segments, no order should be placed nor any value accepted. This allows the send to retransmit the entire message, with possible modifications, at a later time without order duplication.

5.4 HL7 v2.x Equivalent XML Syntax

The HL7 Abstract Message syntax for the simple test result message describes the structure for the elements of the XML-encoded message. Recall that the Abstract Message syntax is as follows:

	Point-of-care Observation
MSH	Message Header
PID	Patient Identification
ORC	Common Order information
OBR	Observation Request
[NTE]	Comment attached to entire result
{	
OBX	Observation Result
[NTE]	Note or Comments attached to each observation result
}	

Using the HL7 v2.3.1 Document Type Definitions (DTDs) and the message values from the previous example, the XML-encoded message would look like the following:

5.5 Sample Message Exchange (XML Encoding)

Note: In the following samples the designations <VT>, <CR>, and <FS> represent the ASCII characters 11, 13, and 28 and not XML Tags.. Individual segments are placed on separate lines for readability; this does not imply the presence of a <CR>, <LF>, or other end of line designation unless explicitly expressed.

5.5.1 Use Case #1, Preordered Test with Single Valued Result

ORU^R01 Observation Result Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<!DOCTYPE ORU_R01 SYSTEM "hl7_v231.dtd">
<ORU_R01>
   <MSH>                                  <!-- MESSAGE HEADER SEGMENT -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>             <!--Encoding characters -->
      <MSH.3>                             <!--Sending Application -->
         <HD.1>CICDMS</HD.1>
      </MSH.3>
      <MSH.4>>                            <!--Sending Facility -->
         <HD.1>OBSREP</HD.1>
      </MSH.4
      <MSH.5>>                            <!--Receiving Application -->
         <HD.1>CICLIS</HD.1>
      </MSH.5
      <MSH.6>>                            <!--Receiving Facility -->
         <HD.1>OBSREV</HD.1>
      </MSH.6
      <MSH.7>20000610010355</MSH.7>       <!--Date/Time of message -->
      <MSH.9>                             <!--Message type -->
```



```
      <CM_MSG_TYPE.1>ORU</CM_MSG_TYPE.1>
      <CM_MSG_TYPE.2>R01</CM_MSG_TYPE.2>
   </MSH.9>
   <MSH.10>20000610010355:023</MSH.10>  <!--Message control ID -->
   <MSH.11>                             <!--Processing ID (T/D/P)-->
      <PT.1>P</PT.1>
   </MSH.11>                            <!--Processing ID (Train/Debug/Prod)-->
   <MSH.12>                             <!--Version ID-->
      <VID.1>2.3.1</VID.1>
   </MSH.12>
   <MSH.15>AL</MSH.15>                  <!--Accept Acknowledgement type, Always -->
   <MSH.16>AL</MSH.16>                  <!--Application Acknowledgement type, Always -->
</MSH>

<PID>                                   <!--PATIENT IDENTIFICATION SEGMENT -->
   <PID.3>                              <!--Patient ID (internal) -->
      <CX.1>12345678</CX.1>
      <CX.4>1</CX.4>
   </PID.3>
   <PID.18>                             <!--Account Number, if required -->
      <CX.1>135792468</CX.1>
      <CX.4>1</CX.4>
   </PID.18>
</PID>

<ORC>                                   <!-- COMMMON ORDER SEGMENT -->
   <ORC.1>RE</ORC.1>                    <!--Order Control, Observations Follow -->
</ORC>

<OBR>                                   <!-- OBSERVATION REQUEST SEGMENT -->
   <OBR.2>
      <EI.1>A24680</EI.1>               <!--Accession Number/Order Id of Test -->
   </OBR.2>
   <OBR.4>                              <!--Universal service ID -->
      <CE.1>L12345</CE.1>               <!--LOINC Code -->
      <CE.2>GLU</CE.2>                  <!--Mnemonic Code -->
   </OBR.4>
   <OBR.11>O</OBR.11>                   <!--Specimen Type -->
   <OBR.16>                             <!--Ordering Provider, if required -->
      <XCN.1>555</XCN.1>                <!--Doctor's ID -->
      <XCN.2>Smith</XCN.2>              <!--Doctor's Name -->
      <XCN.3>John</XCN.3>
      <XCN.4>J</XCN.4>
      <XCN.5>Dr</XCN.5>
   </OBR.16>
</OBR>
 <OBX>                                 <!-- OBSERVATION RESULT SEGMENT -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
      <CE.1>L12345</CE.1>               <!--LOINC Code -->
      <CE.2>GLU</CE.2>                  <!--Mnemonic Code -->
   </OBX.3>
   <OBX.5>120</OBX.5>                   <!--Observation value -->
```



```
      <OBX.6>                              <!--Observation units -->
         <CE.1>mg/dl</CE.1>
      </OBX.6>
      <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
      <OBX.14>20000609102135</OBX.14>      <!--Observation time -->
      <OBX.15>                             <!--Producer ID (device GUID) -->
         <CE.1>LifeScan SureStep</CE.1>
         <CE.2>77777</CE.2>
      </OBX.15>
       <OBX.16>                            <!--Responsible observer (user id) -->
         <XCN.1>9876</XCN.1>
      </OBX.16>
   </OBX>

   <NTE>                                   <!--NOTES AND COMMENTS SEGMENT -->
      <NTE.3>Stat~Physician notified</NTE.3>   <!--Use "~" to separate comments -->
   </NTE>
</ORU_R01>
```

CICLIS must reply immediately with either a Commit ACK specifying CA, CE, or CR. CICLIS generates its own Message Control ID and uses the Message Control ID field from the received message for MSA;2. For success:

```
<!DOCTYPE ACK SYSTEM "hl7_v231.dtd">
<ACK>
   <MSH>                                   <!-- Message Header Segment -->
      <MSH.1>|</MSH.1>                     <!-- Field separator -->
      <MSH.2>^~\&amp;</MSH.2>              <!-- Encoding characters -->
      <MSH.3>
         <HD.1>CICLIS</HD.1>
      </MSH.3>                     <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREV</HD.1>
      </MSH.4>              <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICDMS</HD.1>
      </MSH.5>                  <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREP</HD.1>
      </MSH.6>              <!--Receiving Facility -->
      <MSH.7>20000610010356</MSH.7>        <!-- Date/Time of message -->
      <MSH.9>                              <!--Message type -->
         <CM_MSG_TYPE.1>ACK</CM_MSG_TYPE.1>
      </MSH.9>
      <MSH.10>20000610010356CA</MSH.10>    <!--Message control ID -->
      <MSH.11>
         <PT.1>P</PT.1>
      </MSH.11>                            <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>
         <VID.1>2.3.1</VID.1>
      </MSH.12>                            <!--Version ID -->
      <MSH.15>NE</MSH.15>                  <!--Accept Acknowledgement type -->
      <MSH.16>NE</MSH.16>                  <!--Application Acknowledgement type -->
   </MSH>
```



```
   <MSA>                                  <!-- Message Acknowledge Segment -->
      <MSA.1>CA</MSA.1>                   <!--Ack code (CA=commit accept) -->
      <MSA.2>20000610010355:023</MSA.2>   <!--Msg control ID (from MSH.10) -->
   </MSA>
</ACK>
```

If this were Original Acknowledgment Mode (as may be specified in ORU Message MSH-16, this would be the end of the transfer communication.

For Enhanced Acknowledge Mode (as is specified in ORU Message MSH-16) the following exchanges apply:

Later, the LIS must send an ACK message as an Application Acknowledgment. This message is created similar to the Commit Acknowledgment except that the Message Type is ACK^R01 rather than ACK and the ACK code is AA, AE, or AR.

For success:

```
<!DOCTYPE ACK_R01 SYSTEM "hl7_v231.dtd">
<ACK_R01>
   <MSH>                                  <!-- Message Header Segment -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>             <!--Encoding characters -->
      <MSH.3>
         <HD.1>CICLIS</HD.1>
      </MSH.3>                     <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREV</HD.1>
      </MSH.4>              <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICDMS</HD.1>
      </MSH.5>                  <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREP</HD.1>
      </MSH.6>              <!--Receiving Facility -->
      <MSH.7>20000610010400</MSH.7>       <!--Date/Time of message -->
      <MSH.9>                             <!--Message type -->
         <CM_MSG_TYPE.1>ACK</CM_MSG_TYPE.1>
         <CM_MSG_TYPE.2>R01</CM_MSG_TYPE.2>
      </MSH.9>
      <MSH.10>20000610010400AAA</MSH.10>  <!--Message control ID -->
      <MSH.11>
         <PT.1>P</PT.1>
      </MSH.11>                           <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>
         <VID.1>2.3.1</VID.1>
      </MSH.12>                           <!--Version ID -->
      <MSH.15>AL</MSH.15>                 <!--Accept Acknowledgement type -->
      <MSH.16>NE</MSH.16>                 <!--Application Acknowledgement type -->
   </MSH>

   <MSA>                                  <!-- Message Acknowledge Segment -->
      <MSA.1>AA</MSA.1>                   <!--Ack code (AA=application accept) -->
      <MSA.2>20000610010355:023</MSA.2>   <!--Msg control ID (from MSH.10) -->
   </MSA>
```



```
</ACK_R01>
```

Finally, CICDMS-OBSREP will send a Communication Level ACK message for the LIS ACK Message:

```
<!DOCTYPE ACK SYSTEM "hl7_v231.dtd">
<ACK>
   <MSH>                                  <!-- Message Header Segment -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>             <!--Encoding characters -->
      <MSH.3>
         <HD.1>CICDMS</HD.1>
      </MSH.3>                            <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREP</HD.1>
      </MSH.4>                            <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICLIS</HD.1>
      </MSH.5>                            <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREV</HD.1>
      </MSH.6>                            <!--Receiving Facility -->
      <MSH.7>20000610010401</MSH.7>       <!--Date/Time of message -->
      <MSH.9>                             <!--Message type -->
         <CM_MSG_TYPE.1>ACK</CM_MSG_TYPE.1>
      </MSH.9>
      <MSH.10>20000610010401CA</MSH.10>   <!--Message control ID -->
      <MSH.11>
         <PT.1>P</PT.1>
      </MSH.11>                           <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>
         <VID.1>2.3.1</VID.1>
      </MSH.12>                           <!--Version ID -->
      <MSH.15>NE</MSH.15>                 <!--Accept Acknowledgement type -->
      <MSH.16>NE</MSH.16>                 <!--Application Acknowledgement type -->
   </MSH>

   <MSA>                                  <!-- Message Acknowledge Segment -->
      <MSA.1>CA</MSA.1>                   <!--Ack code (CA=commit accept) -->
      <MSA.2>20000610010400AA</MSA.2>     <!--Msg control ID (from MSH.10) -->
   </MSA>
</ACK>
```

5.5.2 Use Case #2, Unordered Test with Single Valued Result

ORM^O01 General Ordert Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<!DOCTYPE ORM_O01 SYSTEM "hl7_v231.dtd">
<ORM_O01>
   <MSH>                                  <!-- MESSAGE HEADER SEGMENT -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>             <!--Encoding characters -->
```



```
   <MSH.3>
      <HD.1>CICDMS</HD.1>
   </MSH.3>                              <!--Sending Application -->
   <MSH.4>
      <HD.1>OBSREP</HD.1>
   </MSH.4>                              <!--Sending Facility -->
   <MSH.5>
      <HD.1>CICLIS</HD.1>
   </MSH.5>                              <!--Receiving Application -->
   <MSH.6>
      <HD.1>OBSREV</HD.1>
   </MSH.6>                              <!--Receiving Facility -->
   <MSH.7>20000610010355</MSH.7>         <!--Date/Time of message -->
   <MSH.9>                               <!--Message type -->
      <CM_MSG_TYPE.1>ORM</CM_MSG_TYPE.1>
      <CM_MSG_TYPE.2>O01</CM_MSG_TYPE.2>
   </MSH.9>
   <MSH.10>20000610010355:023</MSH.10>   <!--Message control ID -->
   <MSH.11>                              <!--Processing ID (T/D/P)-->
      <PT.1>P</PT.1>
   </MSH.11>                             <!--Processing ID (Train/Debug/Prod)-->
   <MSH.12>                              <!--Version ID-->
      <VID.1>2.3.1</VID.1>
   </MSH.12>
   <MSH.15>AL</MSH.15>                   <!--Accept Acknowledgement type, Always -->
   <MSH.16>AL</MSH.16>                   <!--Application Acknowledgement type, Always -->
</MSH>

<PID>                                    <!--PATIENT IDENTIFICATION SEGMENT -->
   <PID.3>                               <!--Patient ID (internal) -->
      <CX.1>12345678</CX.1>
      <CX.4>1</CX.4>
   </PID.3>
   <PID.18>                              <!--Account Number, if required -->
      <CX.1>135792468</CX.1>
      <CX.4>1</CX.4>
   </PID.18>
</PID>

<ORC>                                    <!-- COMMMON ORDER SEGMENT -->
   <ORC.1>NW</ORC.1>                     <!--Order Control, Observations Follow -->
</ORC>

<OBR>                                    <!-- OBSERVATION REQUEST SEGMENT -->
   <OBR.4>                               <!--Universal service ID -->
      <CE.1>L12345</CE.1>                <!--LOINC Code -->
      <CE.2>GLU</CE.2>                   <!--Mnemonic Code -->
   </OBR.4>
   <OBR.11>O</OBR.11>                    <!--Specimen Type -->
   <OBR.16>                              <!--Ordering Provider, if required -->
      <XCN.1>555</XCN.1>                 <!--Doctor's ID -->
      <XCN.2>Smith</XCN.2>               <!--Doctor's Name -->
      <XCN.3>John</XCN.3>
      <XCN.4>J</XCN.4>
```



```
         <XCN.5>Dr</XCN.5>
      </OBR.16>
   </OBR>

    <OBX>                                <!-- OBSERVATION RESULT SEGMENT -->
      <OBX.2>ST</OBX.2>                  <!--Value type (ST=string) -->
      <OBX.3>                            <!--Observation ID -->
         <CE.1>L12345</CE.1>             <!--LOINC Code -->
         <CE.2>GLU</CE.2>                <!--Mnemonic Code -->
      </OBX.3>
      <OBX.5>120</OBX.5>                 <!--Observation value -->
      <OBX.6>                            <!--Observation units -->
         <CE.1>mg/dl</CE.1>
      </OBX.6>
      <OBX.11>F</OBX.11>                 <!--Observation result status (F=final)-->
      <OBX.14>20000609102135</OBX.14>    <!--Observation time -->
      <OBX.15>                           <!--Producer ID (device GUID) -->
         <CE.1>LifeScan SureStep</CE.1>
         <CE.2>77777</CE.2>
      </OBX.15>
       <OBX.16>                          <!--Responsible observer (user id) -->
         <XCN.1>9876</XCN.1>
      </OBX.16>
   </OBX>

   <NTE>                                 <!--NOTES AND COMMENTS SEGMENT -->
      <NTE.3>Stat~Physician notified</NTE.3>   <!--Use "~" to separate comments -->
   </NTE>
</ORM_O01>
```

CICLIS must reply immediately with either a Commit ACK specifying CA, CE, or CR. CICLIS generates its own Message Control ID and uses the Message Control ID field from the received message for MSA;2. This ACK message is identical to that in Use Case #1.

If this were Original Acknowledgment Mode (as may be specified in ORU Message MSH-16, this would be the end of the transfer communication.

For Enhanced Acknowledge Mode (as is specified in ORU Message MSH-16) the following exchanges apply:

Later, the LIS must send an ACK message as an Application Acknowledgment. This message is created similar to the Commit Acknowledgment except that the Message Type is ORR^O02 rather than ACK and the ACK code is AA, AE, or AR. This message will also return either the Accession Number/Order ID of the ordered test or an application level Error description.

For success:

```
<!DOCTYPE ORR_O02 SYSTEM "hl7_v231.dtd">
<ORR_O02>
   <MSH>                                 <!-- Message Header Segment -->
      <MSH.1>|</MSH.1>                   <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>            <!--Encoding characters -->
```



```
      <MSH.3>
         <HD.1>CICLIS</HD.1>
      </MSH.3>                              <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREV</HD.1>
      </MSH.4>                              <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICDMS</HD.1>
      </MSH.5>                              <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREP</HD.1>
      </MSH.6>                              <!--Receiving Facility -->
      <MSH.7>20000610010400</MSH.7>         <!--Date/Time of message -->
      <MSH.9>                               <!--Message type -->
         <CM_MSG_TYPE.1>ORR</CM_MSG_TYPE.1>
         <CM_MSG_TYPE.2>O02</CM_MSG_TYPE.2>
      </MSH.9>
      <MSH.10>20000610010400AAA</MSH.10>    <!--Message control ID -->
      <MSH.11>
         <PT.1>P</PT.1>
      </MSH.11>                             <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>
         <VID.1>2.3.1</VID.1>
      </MSH.12>                             <!--Version ID -->
      <MSH.15>AL</MSH.15>                   <!--Accept Acknowledgement type -->
      <MSH.16>NE</MSH.16>                   <!--Application Acknowledgement type -->
   </MSH>

   <MSA>                                    <!-- Message Acknowledge Segment -->
      <MSA.1>AA</MSA.1>                     <!--Ack code (AA=application accept) -->
      <MSA.2>20000610010355:023</MSA.2>     <!--Msg control ID (from MSH.10) -->
      <MSA.3>A24680</MSA.3>                 <!--Accession Number/Order ID of Test -->
   </MSA>
</ORR_O02>
```

Otherwise, for an error

```
<!DOCTYPE ORR_O02 SYSTEM "hl7_v231.dtd">
<ORR_O02>
   <MSH>                                    <!-- Message Header Segment -->
      <MSH.1>|</MSH.1>                      <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>               <!--Encoding characters -->
      <MSH.3>
         <HD.1>CICLIS</HD.1>
      </MSH.3>                              <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREV</HD.1>
      </MSH.4>                              <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICDMS</HD.1>
      </MSH.5>                              <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREP</HD.1>
      </MSH.6>                              <!--Receiving Facility -->
      <MSH.7>20000610010400</MSH.7>         <!--Date/Time of message -->
```



```
      <MSH.9>                              <!--Message type -->
         <CM_MSG_TYPE.1>ORR</CM_MSG_TYPE.1>
         <CM_MSG_TYPE.2>O02</CM_MSG_TYPE.2>
      </MSH.9>
      <MSH.10>20000610010400AAA</MSH.10>   <!--Message control ID -->
      <MSH.11>
         <PT.1>P</PT.1>
      </MSH.11>                            <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>
         <VID.1>2.3.1</VID.1>
      </MSH.12>                            <!--Version ID -->
      <MSH.15>AL</MSH.15>                  <!--Accept Acknowledgement type -->
      <MSH.16>NE</MSH.16>                  <!--Application Acknowledgement type -->
   </MSH>

   <MSA>                                   <!-- Message Acknowledge Segment -->
      <MSA.1>AE</MSA.1>                    <!--Ack code (AE=application error) -->
      <MSA.2>20000610010355:023</MSA.2>    <!--Msg control ID (from MSH.10) -->
      <MSA.3>Invalid Patient</MSA.3>       <!--Text Error Message -->
      <MSA.6>                              <!--Error Code, optional description -->
         <CE.1>3129</CE.1>
      </MSA.6>
   </MSA>
</ORR_O02>
```

Finally, CICDMS-OBSREP will send a Communication Level ACK message for the LIS ACK Message. This message is identical to that in Use Case #1.

5.5.3 Use Case #3, Unordered Test with Multi-Valued Result

ORM^O01 General Order Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<!DOCTYPE ORM_O01 SYSTEM "hl7_v231.dtd">
<ORM_O01>
   <MSH>                                  <!-- MESSAGE HEADER SEGMENT -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;amp;</MSH.2>         <!--Encoding characters -->
      <MSH.3>
         <HD.1>CICDMS</HD.1>
      </MSH.3>                            <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREP</HD.1>
      </MSH.4>                            <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICLIS</HD.1>
      </MSH.5>                            <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREV</HD.1>
      </MSH.6>                            <!--Receiving Facility -->
      <MSH.7>20000610010355</MSH.7>       <!--Date/Time of message -->
      <MSH.9>                             <!--Message type -->
         <CM_MSG_TYPE.1>ORM</CM_MSG_TYPE.1>
         <CM_MSG_TYPE.2>O01</CM_MSG_TYPE.2>
      </MSH.9>
      <MSH.10>20000610010355:023</MSH.10> <!--Message control ID -->
      <MSH.11>                            <!--Processing ID (T/D/P)-->
         <PT.1>P</PT.1>
      </MSH.11>                           <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>                            <!--Version ID-->
         <VID.1>2.3.1</VID.1>
      </MSH.12>
      <MSH.15>AL</MSH.15>                 <!--Accept Acknowledgement type, Always -->
      <MSH.16>AL</MSH.16>                 <!--Application Acknowledgement type, Always -->
   </MSH>

   <PID>                                  <!--PATIENT IDENTIFICATION SEGMENT -->
      <PID.3>                             <!--Patient ID (internal) -->
         <CX.1>12345678</CX.1>
         <CX.4>1</CX.4>
      </PID.3>
      <PID.18>                            <!--Account Number, if required -->
         <CX.1>135792468</CX.1>
         <CX.4>1</CX.4>
      </PID.18>
   </PID>

   <ORC>                                  <!-- COMMMON ORDER SEGMENT -->
      <ORC.1>NW</ORC.1>                   <!--Order Control, Observations Follow -->
   </ORC>

   <OBR>                                  <!-- OBSERVATION REQUEST SEGMENT -->
      <OBR.4>                             <!--Universal service ID -->
```



```
         <CE.1>Urine Panel 2</CE.1>          <!--Local Panel Identifier -->
      </OBR.4>
      <OBR.11>O</OBR.11>                     <!--Specimen Type -->
      <OBR.16>                               <!--Ordering Provider, if required -->
         <XCN.1>555</XCN.1>                  <!--Doctor's ID -->
         <XCN.2>Smith</XCN.2>                <!--Doctor's Name -->
         <XCN.3>John</XCN.3>
         <XCN.4>J</XCN.4>
         <XCN.5>Dr</XCN.5>
      </OBR.16>
   </OBR>

    <OBX>                                   <!-- OBSERVATION RESULT SEGMENT (pH)-->
      <OBX.2>ST</OBX.2>                     <!--Value type (ST=string) -->
      <OBX.3>                               <!--Observation ID -->
         <CE.1>L5678</CE.1>                 <!--LOINC Code -->
         <CE.2>pH</CE.2>                    <!--Mnemonic Code -->
      </OBX.3>
      <OBX.5>5.2</OBX.5>                    <!--Observation value (no units)-->
      <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
      <OBX.14>20000609102135</OBX.14>       <!--Observation time -->
      <OBX.15>                              <!--Producer ID (device GUID) -->
         <CE.1>CliniTek 50</CE.1>
         <CE.2>888888</CE.2>
      </OBX.15>
       <OBX.16>                             <!--Responsible observer (user id) -->
         <XCN.1>9876</XCN.1>
      </OBX.16>
   </OBX>

   <OBX>                                    <!-- OBSERVATION RESULT SEGMENT (Ketones) -->
      <OBX.2>ST</OBX.2>                     <!--Value type (ST=string) -->
      <OBX.3>                               <!--Observation ID -->
         <CE.1>L2412</CE.1>                 <!--LOINC Code -->
         <CE.2>Ketones</CE.2>               <!--Mnemonic Code -->
      </OBX.3>
      <OBX.8>N</OBX.8>                      <!--Normal Result (flags vs. value) -->
      <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
      <OBX.14>20000609102135</OBX.14>       <!--Observation time -->
      <OBX.15>                              <!--Producer ID (device GUID) -->
         <CE.1>CliniTek 50</CE.1>
         <CE.2>888888</CE.2>
      </OBX.15>
       <OBX.16>                             <!--Responsible observer (user id) -->
         <XCN.1>9876</XCN.1>
      </OBX.16>
   </OBX>
</ORM_O01>
```

CICLIS ORR^R01 and ACK messages as well as CICDMS-OBSREP ACK message is identical to Use Case #2.

CICLIS must accept the entire order and result combination or must fail the combination without placing any order!

5.5.4 Use Case #4, Unordered Test with Multi-Valued Result

ORM^O01 General Order Message From CICDMS-OBSREP to CICLIS-OBSREV LIS sent 6/10/00 1:03:55

```
<!DOCTYPE ORM_O01 SYSTEM "hl7_v231.dtd">
<ORM_O01>
   <MSH>                                  <!-- MESSAGE HEADER SEGMENT -->
      <MSH.1>|</MSH.1>                    <!--Field separator -->
      <MSH.2>^~\&amp;</MSH.2>             <!--Encoding characters -->
      <MSH.3>
         <HD.1>CICDMS</HD.1>
      </MSH.3>                            <!--Sending Application -->
      <MSH.4>
         <HD.1>OBSREP</HD.1>
      </MSH.4>                            <!--Sending Facility -->
      <MSH.5>
         <HD.1>CICLIS</HD.1>
      </MSH.5>                            <!--Receiving Application -->
      <MSH.6>
         <HD.1>OBSREV</HD.1>
      </MSH.6>                            <!--Receiving Facility -->
      <MSH.7>20000610010355</MSH.7>       <!--Date/Time of message -->
      <MSH.9>                             <!--Message type -->
         <CM_MSG_TYPE.1>ORM</CM_MSG_TYPE.1>
         <CM_MSG_TYPE.2>O01</CM_MSG_TYPE.2>
      </MSH.9>
      <MSH.10>20000610010355:023</MSH.10> <!--Message control ID -->
      <MSH.11>                            <!--Processing ID (T/D/P)-->
         <PT.1>P</PT.1>
      </MSH.11>                           <!--Processing ID (Train/Debug/Prod)-->
      <MSH.12>                            <!--Version ID-->
         <VID.1>2.3.1</VID.1>
      </MSH.12>
      <MSH.15>AL</MSH.15>                 <!--Accept Acknowledgement type, Always -->
      <MSH.16>AL</MSH.16>                 <!--Application Acknowledgement type, Always -->
   </MSH>

   <PID>                                  <!--PATIENT IDENTIFICATION SEGMENT -->
      <PID.1>1</PID.1>                    <!--SET id sequence number of segment -->
      <PID.3>                             <!--Patient ID (internal) -->
         <CX.1>12345678</CX.1>
         <CX.4>1</CX.4>
      </PID.3>
      <PID.5>                             <!--Patient lastname, firstname -->
         <XPN.1>Smith</XPN.1>
         <XPN.2>John</XPN.2>
      </PID.5>
      <PID.8>M</PID.8>                    <!--Sex (‘M’ale,’F’emale,’U’nknown) -->
      <PID.18>                            <!--Account Number, if required -->
         <CX.1>135792468</CX.1>
         <CX.4>1</CX.4>
      </PID.18>
   </PID>
```



```
<ORC>                                  <!-- COMMMON ORDER SEGMENT -->
   <ORC.1>NW</ORC.1>                   <!--Order Control, Observations Follow -->
</ORC>

<OBR>                                  <!-- OBSERVATION REQUEST SEGMENT -->
   <OBR.1>1</OBR.1>                    <!--SET id sequence number of segment -->
   <OBR.4>                             <!--Universal service ID -->
      <CE.1>BG-OXI-ELECT</CE.1>        <!--Local Panel Identifier -->
   </OBR.4>
   <OBR.11>O</OBR.11>                  <!--Specimen Action Code-->
   <OBR.15>                            <!--Specimen Source -->
      <CM.1>BLDA</CM.1>                <!--Blood Arterial -->
      <CM.4>LLFA</CM.4>                <!--Lower left forearm -->
   </OBR.15>
   <OBR.16>                            <!--Ordering Provider, if required -->
      <XCN.1>5555</XCN.1>              <!--Doctor's ID -->
      <XCN.2>Smith</XCN.2>             <!--Doctor's Name -->
      <XCN.3>John</XCN.3>
      <XCN.4>J</XCN.4>
      <XCN.5>Dr</XCN.5>
   </OBR.16>
   <OBR.18>                             <!--Local sample # (assigned by DMS or POC device-->
      <EI.1>8024</EI.1>
      <EI.2>Sample #</EI.2>
   </OBR.18>
</OBR>

<NTE>                  <!--- NOTES AND COMMENTS SEGMENT dealing with battery of results-->
   <NTE.1>1</NTE.1>                    <!--SET id sequence number of segment -->
       <NTE.3>Battery approved by JAG~Dr. G. John notified of result</NTE.3>
                       <!--comment (who approved result + extra comments) -->
</NTE>

 <OBX>                                <!-- OBSERVATION RESULT SEGMENT (pO2)-->
   <OBX.1>1</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>2703-1</CE.1>              <!--LOINC Code -->
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>pO2</CE.4.1>          <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
   <OBX.5>110</OBX.5>                  <!--Observation value-->
   <OBX.6>mmHg</OBX.6>                 <!--Observation units-->
   <OBX.8>H</OBX.8>                    <!--Abnormal Flag ('H'igh)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
   <OBX.14>20000609102135</OBX.14>     <!--Observation time (INCLUDED ONLY IN 1ST OBX) -->
   <OBX.15>                       <!--Producer ID (device GUID) (INCLUDED ONLY IN 1ST OBX)-->
      <CE.1>CICDEV-MULTRES</CE.1>
```



```
        <CE.2>222</CE.2>
      </OBX.15>
       <OBX.16>                  <!--Responsible observer (user id) (INCLUDED ONLY IN 1ST OBX)-->
        <XCN.1>9876</XCN.1>
      </OBX.16>
   </OBX>

   <NTE>                                  <!--NOTES AND COMMENTS SEGMENT-->
      <NTE.1>1</NTE.1>                    <!--SET id sequence number of segment -->
      <NTE.3>Stat~Measured value above reference range but within the critical limits</NTE.3>
                  <!--comment (application error code) -->
   </NTE>

   <OBX>                                  <!-- OBSERVATION RESULT SEGMENT (pCO2)-->
      <OBX.1>2</OBX.1>                    <!--SET id sequence number of segment -->
      <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
      <OBX.3>                             <!--Observation ID -->
         <CE.1>11557-6</CE.1>             <!--LOINC Code -->
         <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
         <CE.4>
            <CE.4.1>pCO2</CE.4.1>         <!--Alternate service id (mnemonic) -->
            <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
         </CE.4>
      </OBX.3>
      <OBX.5>33.2</OBX.5>                 <!--Observation value-->
      <OBX.6>mmHg</OBX.6>                 <!--Observation units-->
      <OBX.8>L</OBX.8>                    <!--Abnormal Flag ('L'ow)-->
      <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
   </OBX>

   <NTE>                                  <!--NOTES AND COMMENTS SEGMENT-->
      <NTE.1>1</NTE.1>                    <!--SET id sequence number of segment -->
      <NTE.3>Stat~Measured value below reference range but within the critical limits</NTE.3>
<!--comment (application error code) -->
   </NTE>

   <OBX>                                  <!-- OBSERVATION RESULT SEGMENT (pH)-->
      <OBX.1>3</OBX.1>                    <!--SET id sequence number of segment -->
      <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
      <OBX.3>                             <!--Observation ID -->
         <CE.1>11558-4</CE.1>             <!--LOINC Code -->
         <CE.2>pH</CE.2>
         <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
         <CE.4>
            <CE.4.1>pH</CE.4.1>           <!--Alternate service id (mnemonic) -->
            <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
         </CE.4>
      </OBX.3>
      <OBX.5>7.474</OBX.5>                <!--Observation value-->
      <OBX.8>H</OBX.8>                    <!--Abnormal Flag ('H'igh)-->
      <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
   </OBX>
```



```
<NTE>                                  <!--NOTES AND COMMENTS SEGMENT-->
   <NTE.1>1</NTE.1>                    <!--SET id sequence number of segment -->
   <NTE.3>Stat~Measured value above reference range but within the critical limits</NTE.3>
                                       <!--comment (application error code) -->
</NTE>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (K+)-->
   <OBX.1>4</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>6298-4</CE.1>              <!--LOINC Code -->
      <CE.2>POTASSIUM</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>K+</CE.4.1>           <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
   <OBX.5>3.7</OBX.5>                  <!--Observation value-->
   <OBX.6>mmol/L</OBX.6>               <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (tHb)-->
   <OBX.1>5</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>14775-1</CE.1>             <!--LOINC Code -->
      <CE.2>HEMOGLOBIN</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>tHb</CE.4.1>           <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
   <OBX.5>11.6</OBX.5>                 <!--Observation value-->
   <OBX.6>g/dL</OBX.6>                 <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (RHb)-->
   <OBX.1>6</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>4536-9</CE.1>              <!--LOINC Code -->
      <CE.2>DEOXYHEMOGLOBIN/HEMOGLOBIN.TOTAL</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>RHb</CE.4.1>          <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
```



```
      </CE.4>
   </OBX.3>
   <OBX.5>1.3</OBX.5>                  <!--Observation value-->
   <OBX.6>%</OBX.6>                    <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (O2Hb)-->
   <OBX.1>7</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.4>
         <CE.4.1>O2Hb</CE.4.1>         <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
   <OBX.5>96.9</OBX.5>                 <!--Observation value-->
   <OBX.6>%</OBX.6>                    <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (COHb)-->
   <OBX.1>8</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>20563-3</CE.1>             <!--LOINC Code -->
      <CE.2>CARBON MONOXIDE.HEMOGLOBIN</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>COHb</CE.4.1>         <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
   <OBX.5>1.2</OBX.5>                  <!--Observation value-->
   <OBX.6>%</OBX.6>                    <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (MetHb)-->
   <OBX.1>9</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>2614-6</CE.1>              <!--LOINC Code -->
      <CE.2>METHEMOGLOBIN/HEMOGLOBIN.TOTAL</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>MetHb</CE.4.1>        <!--Alternate service id (mnemonic) -->
         <CE.4.2>M</CE.4.2>            <!--Alternate service id (type = measured) -->
      </CE.4>
   </OBX.3>
```



```
   <OBX.5>0.6</OBX.5>                  <!--Observation value-->
   <OBX.6>%</OBX.6>                    <!--Observation units-->
   <OBX.8>N</OBX.8>                    <!--Abnormal Flag ('N'ormal)-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (Temp)-->
   <OBX.1>10</OBX.1>                   <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>20092-3</CE.1>             <!--LOINC Code -->
      <CE.2>BODY TEMPERATURE</CE.2>
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>T</CE.4.1>            <!--Alternate service id (mnemonic) -->
         <CE.4.2>I</CE.4.2>            <!--Alternate service id (type = input) -->
      </CE.4>
   </OBX.3>
   <OBX.5>35.3</OBX.5>                 <!--Observation value-->
   <OBX.6>Cel</OBX.6>                  <!--Observation units-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (FIO2)-->
   <OBX.1>11</OBX.1>                   <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
      <CE.1>19994-3</CE.1>             <!--LOINC Code -->
      <CE.3>LN</CE.3>                  <!--Identity of Coding system = LOINC -->
      <CE.4>
         <CE.4.1>FIO2</CE.4.1>         <!--Alternate service id (mnemonic) -->
         <CE.4.2>I</CE.4.2>            <!--Alternate service id (type = input) -->
      </CE.4>
   </OBX.3>
   <OBX.5>30.0</OBX.5>                 <!--Observation value-->
   <OBX.6>%</OBX.6>                    <!--Observation units-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (pH(T))-->
   <OBX.1>12</OBX.1>                   <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                   <!--Value type (ST=string) -->
   <OBX.3>                             <!--Observation ID -->
     <CE.4>
         <CE.4.1>pH(T)</CE.4.1>        <!--Alternate service id (mnemonic) -->
         <CE.4.2>C</CE.4.2>            <!--Alternate service id (type = calculated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>7.500</OBX.5>                <!--Observation value-->
   <OBX.11>F</OBX.11>                  <!--Observation result status (F=final)-->
</OBX>

<OBX>                                  <!-- OBSERVATION RESULT SEGMENT (pCO2(T))-->
```



```
   <OBX.1>13</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
     <CE.4>
         <CE.4.1>pCO2(T)</CE.4.1>       <!--Alternate service id (mnemonic) -->
         <CE.4.2>C</CE.4.2>             <!--Alternate service id (type = calculated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>30.5</OBX.5>                  <!--Observation value-->
   <OBX.6>mmHg</OBX.6>                  <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>

<OBX>                                   <!-- OBSERVATION RESULT SEGMENT (SBE)-->
   <OBX.1>14</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
     <CE.1>19235-1</CE.1>               <!--LOINC Code -->
     <CE.3>LN</CE.3>                    <!--Identity of Coding system = LOINC -->
     <CE.4>
         <CE.4.1>SBE</CE.4.1>           <!--Alternate service id (mnemonic) -->
         <CE.4.2>C</CE.4.2>             <!--Alternate service id (type = calculated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>0.8</OBX.5>                   <!--Observation value-->
   <OBX.6>mmol/L</OBX.6>                <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>

<OBX>                                   <!-- OBSERVATION RESULT SEGMENT (SBC)-->
   <OBX.1>15</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
     <CE.1>19230-2</CE.1>               <!--LOINC Code -->
     <CE.3>LN</CE.3>                    <!--Identity of Coding system = LOINC -->
     <CE.4>
         <CE.4.1>SBC</CE.4.1>           <!--Alternate service id (mnemonic) -->
         <CE.4.2>C</CE.4.2>             <!--Alternate service id (type = calculated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>25.6</OBX.5>                  <!--Observation value-->
   <OBX.6>mmol/L</OBX.6>                <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>

<OBX>                                   <!-- OBSERVATION RESULT SEGMENT (Hct)-->
   <OBX.1>16</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
     <CE.1>20570-8</CE.1>               <!--LOINC Code -->
     <CE.3>LN</CE.3>                    <!--Identity of Coding system = LOINC -->
     <CE.4>
         <CE.4.1>Hct</CE.4.1>           <!--Alternate service id (mnemonic) -->
```



```
          <CE.4.2>C</CE.4.2>              <!--Alternate service id (type = calculated) -->
       </CE.4>
    </OBX.3>
    <OBX.5>35.7</OBX.5>                   <!--Observation value-->
    <OBX.6>%</OBX.6>                      <!--Observation units-->
    <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
</OBX>

<OBX>                                     <!-- OBSERVATION RESULT SEGMENT (pO2(T))-->
    <OBX.1>17</OBX.1>                     <!--SET id sequence number of segment -->
    <OBX.2>ST</OBX.2>                     <!--Value type (ST=string) -->
    <OBX.3>                               <!--Observation ID -->
      <CE.1>19254-2</CE.1>                <!--LOINC Code -->
      <CE.3>LN</CE.3>                     <!--Identity of Coding system = LOINC -->
      <CE.4>
          <CE.4.1>pO2(T)</CE.4.1>         <!--Alternate service id (mnemonic) -->
          <CE.4.2>C</CE.4.2>              <!--Alternate service id (type = calculated) -->
       </CE.4>
    </OBX.3>
    <OBX.5>101</OBX.5>                    <!--Observation value-->
    <OBX.6>mmHg</OBX.6>                   <!--Observation units-->
    <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
</OBX>
<OBX>                                     <!-- OBSERVATION RESULT SEGMENT (p50(act))-->
    <OBX.1>18</OBX.1>                     <!--SET id sequence number of segment -->
    <OBX.2>ST</OBX.2>                     <!--Value type (ST=string) -->
    <OBX.3>                               <!--Observation ID -->
      <CE.1>19214-6</CE.1>                <!--LOINC Code -->
      <CE.3>LN</CE.3>                     <!--Identity of Coding system = LOINC -->
      <CE.4>
          <CE.4.1>p50(act)</CE.4.1>       <!--Alternate service id (mnemonic) -->
          <CE.4.2>E</CE.4.2>              <!--Alternate service id (type = estimated) -->
       </CE.4>
    </OBX.3>
    <OBX.5>24.15</OBX.5>                  <!--Observation value-->
    <OBX.6>mmHg</OBX.6>                   <!--Observation units-->
    <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
</OBX>
<OBX>                                     <!-- OBSERVATION RESULT SEGMENT (AaDpO2))-->
    <OBX.1>19</OBX.1>                     <!--SET id sequence number of segment -->
    <OBX.2>ST</OBX.2>                     <!--Value type (ST=string) -->
    <OBX.3>                               <!--Observation ID -->
       <CE.4>
          <CE.4.1>AaDpO2</CE.4.1>         <!--Alternate service id (mnemonic) -->
          <CE.4.2>E</CE.4.2>              <!--Alternate service id (type = estimated) -->
       </CE.4>
    </OBX.3>
    <OBX.5>59.1</OBX.5>                   <!--Observation value-->
    <OBX.6>mmHg</OBX.6>                   <!--Observation units-->
    <OBX.11>F</OBX.11>                    <!--Observation result status (F=final)-->
</OBX>
<OBX>                                     <!-- OBSERVATION RESULT SEGMENT (AaDpO2,T))-->
```



```
   <OBX.1>20</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
      <CE.4>
         <CE.4.1>AaDpO2,T</CE.4.1>      <!--Alternate service id (mnemonic) -->
         <CE.4.2>E</CE.4.2>             <!--Alternate service id (type = estimated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>72.0</OBX.5>                  <!--Observation value-->
   <OBX.6>mmHg</OBX.6>                  <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>
<OBX>                                   <!-- OBSERVATION RESULT SEGMENT (tO2))-->
   <OBX.1>21</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
      <CE.4>
         <CE.4.1>tO2</CE.4.1>           <!--Alternate service id (mnemonic) -->
         <CE.4.2>C</CE.4.2>             <!--Alternate service id (type = calculated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>15.9</OBX.5>                  <!--Observation value-->
   <OBX.6>Vol%</OBX.6>                  <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>
<OBX>                                   <!-- OBSERVATION RESULT SEGMENT (RI))-->
   <OBX.1>22</OBX.1>                    <!--SET id sequence number of segment -->
   <OBX.2>ST</OBX.2>                    <!--Value type (ST=string) -->
   <OBX.3>                              <!--Observation ID -->
      <CE.4>
         <CE.4.1>RI</CE.4.1>            <!--Alternate service id (mnemonic) -->
         <CE.4.2>E</CE.4.2>             <!--Alternate service id (type = estimated) -->
      </CE.4>
   </OBX.3>
   <OBX.5>54</OBX.5>                    <!--Observation value-->
   <OBX.6>%</OBX.6>                     <!--Observation units-->
   <OBX.11>F</OBX.11>                   <!--Observation result status (F=final)-->
</OBX>
```

CICLIS ORR^R01 and ACK messages as well as CICDMS-OBSREP ACK message is identical to Use Case #2.

CICLIS must accept the entire order and result combination or must fail the combination without placing any order!

6 Notes