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IHE Patient Care Device (PCD) Technical Framework Supplement 2008-2009

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Alarm Communication Management (ACM)

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**Draft for Trial Implementation
August 22, 2008**

1 Foreword

20 Integrating the Healthcare Enterprise (IHE) is an initiative designed to stimulate the integration
of the information systems that support modern healthcare institutions. Its fundamental objective
is to ensure that in the care of patients all required information for medical decisions is both
correct and available to healthcare professionals. The IHE initiative is both a process and a
25 forum for encouraging integration efforts. It defines a technical framework for the
implementation of established messaging standards to achieve specific clinical goals. It includes
a rigorous testing process for the implementation of this framework. And it organizes
educational sessions and exhibits at major meetings of medical professionals to demonstrate the
benefits of this framework and encourage its adoption by industry and users.

The approach employed in the IHE initiative is not to define new integration standards, but rather
30 to support the use of existing standards, HL7, DICOM, IETF, and others, as appropriate in their
respective domains in an integrated manner, defining configuration choices when necessary.
IHE maintain formal relationships with several standards bodies including HL7, DICOM and
refers recommendations to them when clarifications or extensions to existing standards are
necessary.

35 This initiative has numerous sponsors and supporting organizations in different medical specialty
domains and geographical regions. In North America the primary sponsors are the Healthcare
Information and Management Systems Society (HIMSS) and the Radiological Society of North
America (RSNA). IHE Canada has also been formed. IHE Europe (IHE-EUR) is supported by a
large coalition of organizations including the European Association of Radiology (EAR) and
40 European Congress of Radiologists (ECR), the Coordination Committee of the Radiological and
Electromedical Industries (COCIR), Deutsche Röntgengesellschaft (DRG), the EuroPACS
Association, Groupement pour la Modernisation du Système d'Information Hospitalier
(GMSIH), Société Française de Radiologie (SFR), Società Italiana di Radiologia Medica
(SIRM), the European Institute for health Records (EuroRec), and the European Society of
45 Cardiology (ESC). In Japan IHE-J is sponsored by the Ministry of Economy, Trade, and
Industry (METI); the Ministry of Health, Labor, and Welfare; and MEDIS-DC; cooperating
organizations include the Japan Industries Association of Radiological Systems (JIRA), the
Japan Association of Healthcare Information Systems Industry (JAHIS), Japan Radiological
Society (JRS), Japan Society of Radiological Technology (JSRT), and the Japan Association of
50 Medical Informatics (JAMI). Other organizations representing healthcare professionals are
invited to join in the expansion of the IHE process across disciplinary and geographic
boundaries.

The IHE Technical Frameworks for the various domains (IT Infrastructure, Cardiology,
Laboratory, Radiology, etc.) defines specific implementations of established standards to achieve
55 integration goals that promote appropriate sharing of medical information to support optimal
patient care. It is expanded annually, after a period of public review, and maintained regularly
through the identification and correction of errata. The current version for these Technical
Frameworks may be found at www.ihe.net/Technical_Framework.

60 The IHE Technical Framework identifies a subset of the functional components of the healthcare
enterprise, called IHE Actors, and specifies their interactions in terms of a set of coordinated,
standards-based transactions. It describes this body of transactions in progressively greater
depth. The volume I provides a high-level view of IHE functionality, showing the transactions
organized into functional units called Integration Profiles that highlight their capacity to address
65 specific clinical needs. The subsequent volumes provide detailed technical descriptions of each
IHE transaction.

This Supplement is submitted for Public Comment through May 2009.

**Comments and change proposals may be submitted to: <http://forums.rsna.org>
under the “IHE” forum**

Select the sub-forum

70 ***“Patient Care Device Supplements 2008-2009 for Public Review”***

**The IHE Patient Care Device (PCD) Technical Committee will address comments resulting
from implementation, Connectathon testing and demonstrations (such as HIMSS 09 IHE
Showcase). Final text expected to be published in June 2009, dependant upon results of
IHE validation process.**

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2 Introduction

2.1 Open Issues and Questions

- 105 There was consensus that snippets from ECG or other physiological waveforms associated with alarms were desirable to provide for in this document, but it was decided to defer the definition of the format to next year given that there were several possible precedents, no clear choice, and it seemed unlikely that any example implementations would be implemented in the first cycle.

2.2 Closed Issues

- 110 It was decided to treat alarm representation in HL7 as an extension of previous PCD work for observation reporting from patient care devices, with multiple OBX segments representing the aspects of an alarm that did not go beyond what could readily be represented in the single OBX segment per parameter model previously used.
- 115 ISO/IEEE 11073 was selected as the preferred coding system for parameters and events to be used in the communication of alarms. If no applicable term is available in that nomenclature and a LOINC term is, the LOINC term may be used.
- 120 Aside from that which is directly affected by this profile, communication and functionality within alarm manager systems and the communication protocols, messaging, and presentation used between alarm manager systems and alarm dissemination and alarm endpoint client systems is not within the scope of this profile.
- Systems covered by this document shall pass through rather than modify alarms created by patient care devices, and shall not create additional alarms based on interpreting alarms or based on correlating alarms from different alarm reporting systems.

Profile Abstract

- 125 This supplement extends the Device Enterprise Communication profile of the IHE Patient Care Devices domain to further specify the communication of alarm data describing states and events significant to patient care from patient care devices to alarm manager systems (systems which route alarms to end devices for notification of caregivers, or to other systems that record patient care information).
- 130 These alarms may be physiological, that is, representing the physiological state of the patient (such as a heart rate above or below a caregiver-specified safe range for the patient), or technical, reflecting conditions in the patient care devices themselves that may require action from caregivers (such as ECG leads off the patient).
- 135 The intent of this supplement is to give a uniform way of representing such common alarm conditions in HL7 messages to facilitate interoperability of systems from different vendors.

3 GLOSSARY

ACM – Alarm Communication Management

Physiological alarm - an alarm reflecting the physiological state of the patient (such as a heart rate above or below a caregiver-specified safe range for the patient).

- 140 Primary Alarm System - the patient care device itself provides visual and aural indications of alarms that can be seen and heard in the immediate patient vicinity, and that are the authoritative primary indicators of alarms resulting from monitoring the patient. It is understood that caregivers shall be in a position to take immediate action based on these primary alarm indications and shall not rely exclusively on secondary alarm systems for alarm notifications.
- 145 Secondary alarm system - a system intended to give "best effort" notification of alarms at additional locations, to additional persons, or for additional purposes such as archiving, but not intended to take the place of a primary alarm system as the authoritative primary indicator of alarms resulting from monitoring the patient.
- 150 Technical alarm - an alarm reflecting the state of the patient care device themselves that may require action from caregivers (such as ECG leads off the patient).

Volume I – Integration Profiles

This section describes the changes required in Volume I of the Technical Framework that result from including this Integration Profile.

155 History of Annual Changes

The Alarm Communication Management integration profile defines the communication of alarms from alarm source systems to alarm manager systems and from alarm manager systems to alarm archiver systems.

Add the following bullet to the end of the bullet list in section 1.7

- 160
- Added the ACM Profile which defines the communication of alarms from alarm source systems to alarm manager systems and from alarm manager systems to alarm archiver systems.

Add the following section to Table 2-1 Integration Profiles Dependencies in section 2.1

Patient Identifier Cross Referencing (PIX) Profile [add minimum required profiles for ACM actor implementors, consistent time (system to within 2 seconds) - MWP]	<?>	<?>	<->
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165

Add the following section to section 2.2

2.2.X ACM Integration Profile

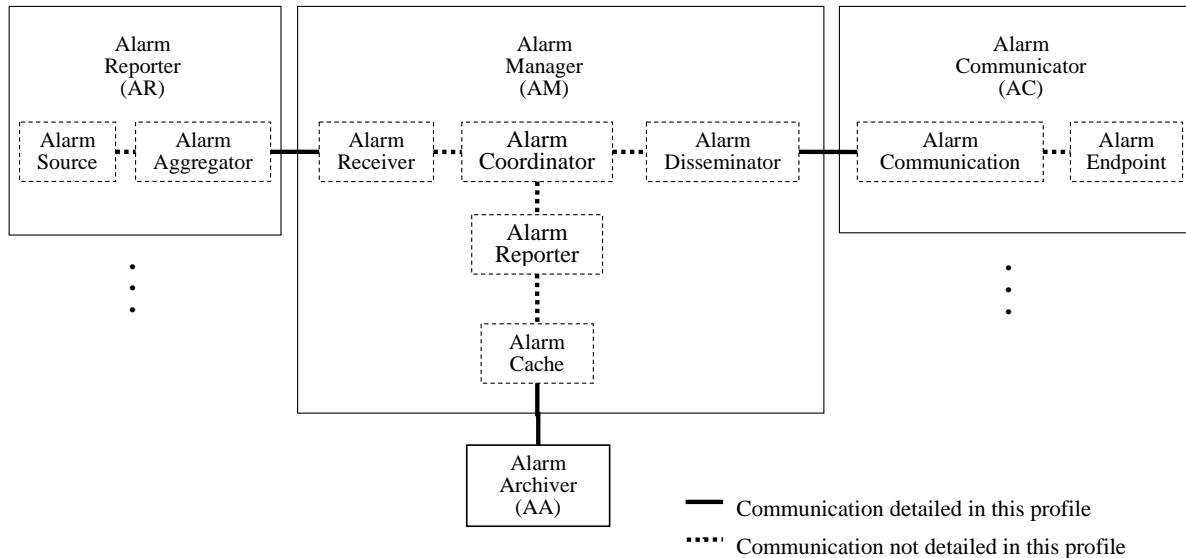
- 170
- This supplement provides for alarm dissemination between alarm source devices and systems, from the connector to and within the communication services to the required abstract semantics, in a manner that, if complied with, enables multi-vendor multi-modality interoperation.

The section shall be added to Vol 1

X ACM Integration Profile

- 175
- This supplement defines the communication of alarms from alarm source systems to alarm manager systems and from alarm manager systems to alarm archiver systems.
- This supplement provides for alarm dissemination between alarm source devices and systems, from the connector to and within the communication services to the required abstract semantics, in a manner that, if complied with, enables multi-vendor multi-modality interoperation.

180 The intended use of the IHE PCD Alarm Communications Management Profile is to serve in communication of alarm information from patient care devices to an alarm manager system communicating with secondary means of notification to caregivers. Typical secondary notification means would be annunciators, pagers, and smart phones.

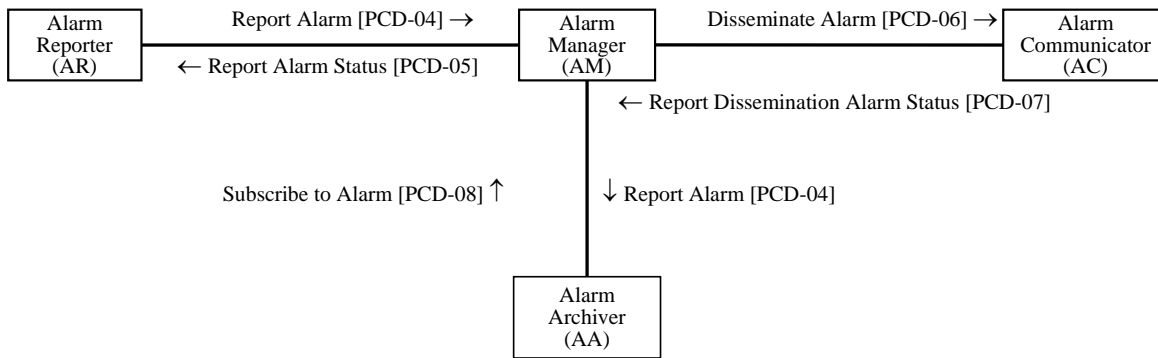


Out of Scope

This profile is not for use in any part of a primary alarming system or any system deriving new alarms or modifying the identification or priority value of the alarm from the patient care device.

185 **X.1 Actors/ Transactions**

Figure X.1-1 shows the actors directly involved in the ACM Integration Profile and the relevant transactions between them. Other actors that may be indirectly involved due to their participation in other related profiles, etc. are not necessarily shown.



190 **Figure X.1-1. ACM Profile Actor Diagram**

Table X.1-1 lists the transactions for each actor directly involved in the ACM Profile. In order to claim support of this Integration Profile, an implementation must perform the required transactions (labeled “R”). Transactions labeled “O” are optional. A complete list of options defined by this Integration Profile and that implementations may choose to support is listed in

195 Volume I, Section X.2.

Table X.1-1. ACM Integration Profile - Actors and Transactions

Actors	Transactions	Direction	Optionality	Section in Vol. 2
Alarm Reporter (AR)	Report Alarm [PCD-04]	Outbound	R	3.Y
	Report Alarm Status [PCD-05]	Inbound	O	3.Y+1
Alarm Manager (AM)	Report Alarm [PCD-04]	Inbound	R	3.Y
	Report Alarm Status [PCD-05]	Outbound	O	3.Y+1
	Disseminate Alarm [PCD-06]	Outbound	R	3.Y+2
	Report Dissemination Alarm Status [PCD-07]	Inbound	R	3.Y+4
	Subscribe to Alarm [PCD-08]	Inbound	O	3.Y+5
Alarm Communicator (AC)	Disseminate Alarm [PCD-06]	Inbound	R	3.Y+2
	Report Dissemination Alarm Status [PCD-07]	Outbound	R	3.Y+4
Alarm Archiver (AA)	Subscribe to Alarm [PCD-08]	Outbound	R	3.Y+5
	Report Alarm [PCD-04]	Inbound	R	3.Y

Note: Report Alarm [PCD-04] is reused and may be sent from the AR or AM.

200 X.2 ACM Integration Profile Options

Options that may be selected for this Integration Profile are listed in the table X.2-1 along with the Actors to which they apply. Dependencies between options when applicable are specified in notes.

Table X.2-1 Evidence Documents - Actors and Options

Actor	Transaction	Options	Vol & Section
Alarm Reporter (AR)	Report Alarm [PCD-04]	Subscribe to Alarm Status	3.Y+3

- 205 The option requests the Alarm Manager (AM) to provide the Alarm Reporter (AR) with dissemination status updates with regard to the alarm associated with the transaction.

X.3 ACM Use Cases and Interaction Diagrams

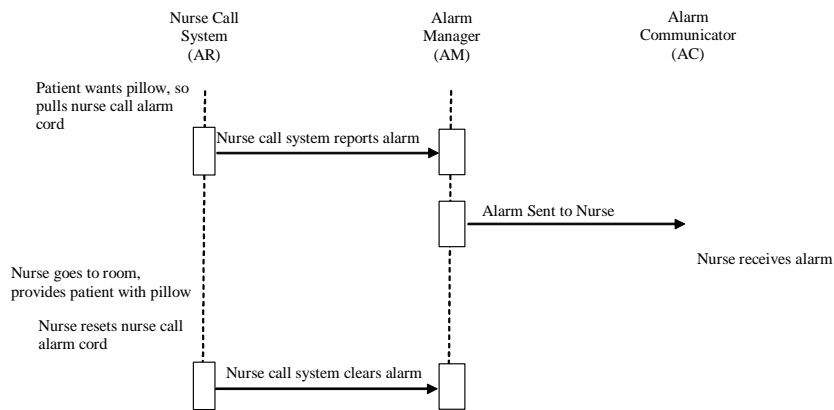
- 210 Alarm Communication Management is meant to improve clinical efficiency by using technology to deliver the right alarms, with the right priority, to the right individuals via devices with the right content, and through configuration escalating communication of alarms to devices associated with other individuals.

- 215 The following are the use cases. The use cases are noticeably generic and not so much focused on the alarm clinical purpose as they are focused on the system interactions. The use cases may be directly applicable to other IHE domains, and may be supplemented with additional use cases to serve specific needs in other domains.

X.3.1 Case A1: Location Sourced

- 220 Use Case – Patient wants a pillow. Patient pulls nurse call. Nurse call system lights the room’s dome light and light at central station. Nurse call system, operating as an Alarm Reporter (AR) actor sends Report Alarm [PCD-04] to Alarm Manager (AM) indicating nurse call alarm. The Alarm Manager (AM) logs receipt of the alarm. The Alarm Manager (AM) identifies the appropriate nurse based upon configured nurse to patient assignments, identifies the appropriate Alarm Communicator (AC) actor and destination communication device based upon nurse to device configuration in Alarm Manager (AM), sends Disseminate Alarm [PCD-06] to nurse’s communication device. The Alarm Manager (AM) logs the dissemination to the Alarm
- 225 Communicator (AC). The nurse receives the alarm on their assigned device. The information minimally includes the patient location (room number). The nurse goes to the room, determines the needs of the patient, and provides the patient with a pillow. The nurse then resets the nurse call pull. The nurse call system turns off the room’s dome light and the light at the central station. The nurse call system, operating as an Alarm Reporter (AR) actor sends Report Alarm
- 230 [PCD-04] to Alarm Manager (AM) indicating reset of the nurse call alarm. The Alarm Manager (AM) receives the alarm turns off any configured alarm escalation and logs the alarm.

235

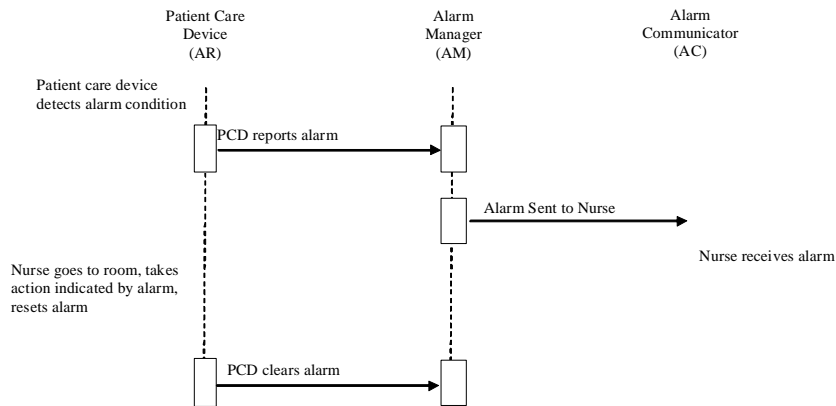


X.3.2 Case A2: Identified Patient Source

PCD Assigned to Patient, Patient Monitoring Alarm Occurs (AR), Sends Alarm to Alarm Mgmt

240

Figure X.3.2 Case A2: Identified Patient Source



System (AM), Alarm to Communication Endpoint (AC). The identification of the patient is known. The location of the patient may be unknown.

X.3.2 Case A3: Same as A1/A2 with Escalation with Cancel at Alarm Source

245 Use Case 3: (same as use case 1 or 2 with escalation with cancel at source) if the communication destination is inaccessible or the target individual is indicated as unavailable, then the alarm is rerouted to one or more alternatives with escalation to higher levels of responsibility until the alarm is canceled at its source and the alarm system notified of the cancel.

X.3.2 Case A4: Same as A1/A2 with Escalation with Cancel at Communication Endpoint

250 Use Case 4: (same as use case 1 or 2 with escalation with cancel at communication endpoint) if the communication destination is inaccessible or the target individual is indicated as unavailable then the alarm is rerouted to one or more alternatives with escalation to higher levels of responsibility until the alarm is canceled by a recipient at a communication endpoint.

X.3.2 Case A5: Same as A1/A2 with Escalation with Cancel at AM

255 Use Case 5: (same as use case 1 or 2 with escalation with cancel at alarm mgmt system) if the communication destination is inaccessible or the target individual is indicated as unavailable then the alarm is rerouted to one or more alternatives with escalation to higher levels of responsibility until the alarm is canceled by a user on the Alarm Manager (AM), however not automatically via algorithms in the Alarm Manager (AM).

260 X.3.2 Case A6: Alarm with no destination other than logging by the Alarm Manager (AM) actor

Use Case 6: The use case for this alarm is to log information with the Alarm Manager (AM) and not to disseminate the alarm to the Alarm Communicator (AC). The information can be marker informaton meant for logs or alarm technical information not meant for dissemination to users.

265 X.4 ACM Security Considerations

This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

<Appendix A> Actor Summary Definitions

Alarm Reporter – The Alarm Reporter (AR) actor sources the alarm to Alarm Manager (AM).

270 **Alarm Manager** – The Alarm Manager (AM) actor receives the alarm from the Alarm Reporter (AR), potentially analyzes the alarm, and dispatches the alarm to the Alarm Communicator (AC).

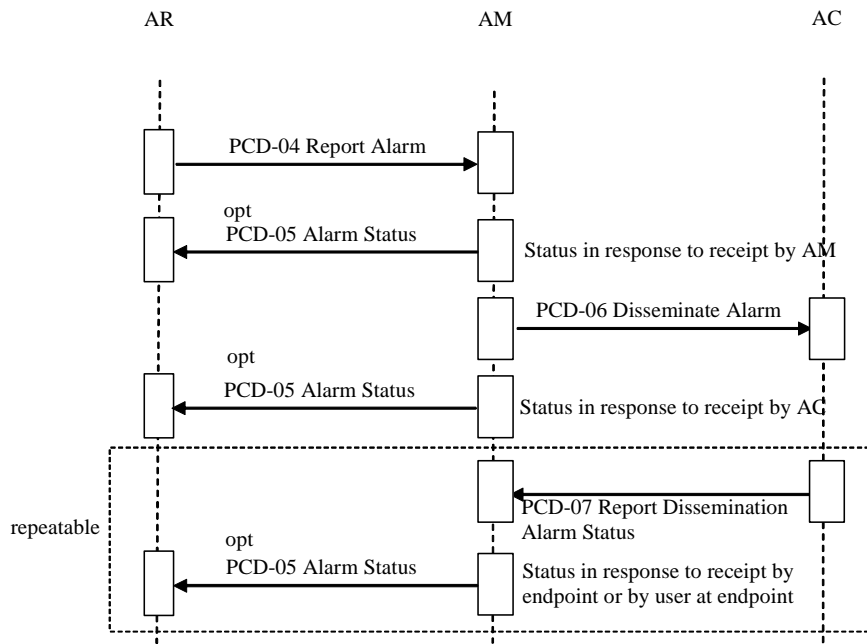
Alarm Communicator – The Alarm Communicator (AC) actor receives the alarm from the Alarm Manager (AM) and sends the alarm to the client application in the endpoint device.

275 Communication between these actors is covered in this profile. Communication between functional units within an actor is not covered in this profile.

Alarm Archiver – The Alarm Archiver (AA) actor sends alarm subscription requests to the AM actor and receives report alarm responses from the AM actor.

Comment [LAS1]: Missing Figure Title

280 This profile specifies the required data and data types communicated with the AM actor.



Use Case 5: (same as use case 1 or 2 with escalation with cancel at alarm manager system) if the communication destination is inaccessible or the target individual is indicated as unavailable then the alarm is rerouted to one or more alternatives with escalation to higher levels of responsibility until the alarm is canceled by a user on the Alarm Manager (AM), however not automatically via algorithms in the Alarm Manager (AM).

285

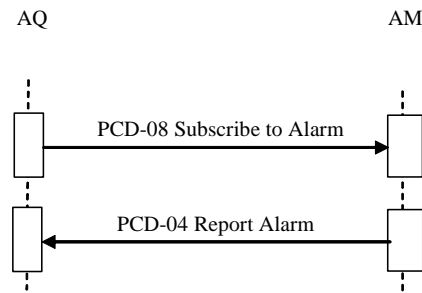
Each actor is identified below. Actor identity can be explicitly provided in the alarm or can be inferred based on the static topological connections of the system.

The functional units comprising an actor may be provided by one or more vendors in one or more systems. Reducing the total number of systems is preferred, but is not required.

290

Data flow of individual use model messaging communication indicates the command response sequences and directions.

Figure X.2-1. Basic Process Flow in ACM Profile



295 **Alarm Reporter (AR) Actor**

This actor originates the alarm.

The semantics and data types used to represent alarm type, alarm priority, alarm inactivation state and escalation and de-escalation of priority in the messages of this actor are based on IEC 60601-1-8 definitions.

300 A single source can produce multiple, possibly concurrent, alarms.

This profile specifies the required data and data types produced by this actor.

This profile specifies communication of the data produced by this actor.

This actor may optionally cancel an outstanding alarm condition.

This may optionally indicate cancellation of any related escalation.

305 An outstanding alarm condition may be optionally escalated via follow-on alarm.

This actor may aggregate and adapt alarms from multiple sources as needed to make them interoperable with the the AM actor. It does not need to be the original source of the alarm data.

In large alarm source populations an aggregation system may be useful for concentration and possible alarm coordination (smart alarming).

310 **Alarm Manager (AM) Actor**

This actor receives alarms from the AR, manages them, and dispatches them to the AC actor.

The semantics and data types used to represent alarm type, alarm priority, alarm inactivation state and escalation and de-escalation of priority in the messages of this actor are based on IEC 60601-1-8 definitions.

315 This profile specifies the required data and data types produced by this actor in communication with the AC and AR actors.

If the following is performed, it is likely performed within the AM.

- Alarm formatting for dissemination
- Alarm harmonization across multiple similar and dissimilar AR
- 320 Any additional alarm priority actioning following any performed by the AR
- Alarm mapping to AC actor endpoints
- Alarm dissemination escalation
- Alarm dissemination sequencing to AC actor endpoints
- Alarm dissemination escalation to AC actor endpoints
- 325 Patient to staff assignments
- Staff to AC actor endpoint assignments
- Alarm reporting
- Alarm caching

330 To accomplish assignments the AM may receive HL7 ADT message feeds from one or more sourcing systems for the following purposes.

- Identify patients
- Assign resources to patients (staff, equipment, rooms)

This profile specifies the required data and data types produced by this actor.

335 This profile does not specify the protocol used in the communication of the data from the AM actor to the AC actor.

Alarm Communicator (AC) Actor

The Alarm Communicator (AC) actor receives alarms from the Alarm Manager (AM) actor. Endpoint devices are connected either directly or indirectly to the Alarm Communicator (AC) actor. The AC may utilize a locally controlled or public infrastructure.

340 The protocol for communication between the AM and AC actors is Simple Mail Transport Protocol (SMTP), also known as E-Mail, as defined in IETF RFC 2821 April, 2001 and RFC 821 August, 1982. The transport protocol is TCP/IP with a default server port of 23. Support for configurability to other ports and use of Secure Socket Layer (SSL) protocol is optional.

345 The required message objects are

- RECIPIENT (RCPT) – destination recipients
- DATA (DATA) – data portion of the message

- 350 Support for Multipurpose Internet Mail Extensions (MIME) RFC 2045 and multi-parts for MIME RFC 1847 is optional.

Reply Codes from the SMTP gateway server may be used as a means of delivery confirmation.

- 355 IETF RFC 3464 Extensible Message Format for Delivery Status Notifications is optional

This profile does not specify the protocol used in the communication of the data to the final destination as it is not controllable by the AC actor. Given that the origination protocol is SMTP there is a common belief that the endpoint communication protocol will be either POP3 or

360 IMAP. However, if the destination referenced by the AC actor is across a gateway system the endpoint protocol may be SIP on a mobile phone.

This profile does not specify the presentation of the data at the endpoint as that is beyond its control.

This profile does not specify the human interface at the endpoint as that is beyond its control.

- 365 **Alarm Archiver (AA) Actor**

This actor sends alarm subscription requests to the AM actor and alarm report responses from the AM actor.

This profile specifies communication with the AM actor.

This profile specifies the required data and data types communicated with the AM actor.

370 <Appendix B> Transaction Summary Definitions

Volume 2 - Transactions

Add sections 3.Y

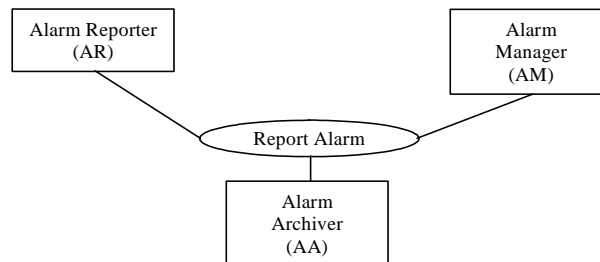
3.Y PCD-04 Report Alarm

375 This section corresponds to Transaction PCD-04 of the IHE Technical Framework. Transaction PCD-04 is used by the Alarm Reporter and the Alarm Manager (AM) actor.

3.Y.1 Scope

380 This transaction is used by the Alarm Reporter to report alarms to the Alarm Manager (AM) and by the Alarm Manager (AM) to report alarms to the Alarm Archiver (AA) actor. The Alarm Reporter (AR) sends alarms to the Alarm Manager (AM) actor in an unsolicited manner. The Alarm Manager (AM) will only send alarms to the Alarm Archiver (AA) if there was a prior subscription.

3.Y.2 Use Case Roles



Actor: Alarm Reporter

385 **Role:** Sends Report Alarm to the Alarm Manager (AM)

Actor: Alarm Manager (AM)

Role: Receives Report Alarm from Alarm Reporter and sends Report Alarm to Alarm Archiver (AA)

Actor: Alarm Archiver (AA)

390 **Role:** .Receives Report Alarm from the Alarm Manager (AM)

3.Y.3 Referenced Standard

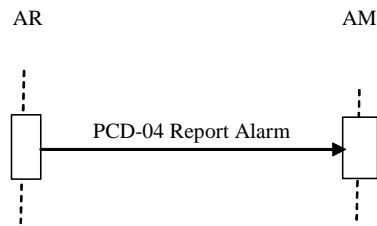
HL7 - Health Level 7 Version 2.5 Ch7 Observation Reporting

ISO/IEEE 11073-10201 Domain Information Model

ISO/IEEE 11073-10101 Nomenclature

395 **3.Y.4 Interaction Diagrams**

3.Y.4.1 AR reports to AM



AR sends Report Alarm to AM as HL7 OBX message

3.Y.4.1.1 HL7 Conformance Statement

400 The conformance statement for this interaction described below is adapted from HL7 2.5.

Publication ID:	R01
Type:	Unsolicited
Publication Name:	IHEPCD-04ReportAlarm
Trigger:	None
Mode:	Immediate
Response:	ORU^R01^ORU_R01
Characteristics:	Sends defined alarm data
Purpose:	Report Alarm from AR to AM
Based on Segment Pattern:	R01

3.Y.4.1.2 PCD-04 Report Alarm (ORU^R01^ORU_R01) static definition

The PCD-04 Report Alarm message is used to communicate ACM data

405 From an Alarm Reporter (AR) to Alarm Manager (AM)

From Alarm Manager (AM) to Alarm Archiver (AA)

Common HL7 segments are defined in Appendix B Common Message Segments.

Device Technical Framework and Appendix C Common Data Types.

410

Table 1 ORU^R01^ORU_R01 static definition

ORU^R01^ORU_R01	ORU Message	Usage	Card.	Section Ref
MSH	Message Header Segment	R	[1..1]	2.15.9
PID	Patient Identification Segment	CE	[1..1]	3.4.2
PV1	Patient Visit Segment	CD	[1..1]	3.4.3
[ORC]	Common Order Segment	O	[1..1]	4.5.1
OBR	Observation Request Segment	R	[1..1]	7.4.1
OBX	Observation Result Segment	R	[1..n]	7.4.2
[NTE]	Notes and Comments Segment	O	[1..1]	2.5.10

<u>ORU^R01^ORU_R01</u>	<u>Report Alarm Message</u>
MSH	Message Header
[[SFT]]	Software Segment
{	--- ALARM_begin
[--- PATIENT begin
PID	Patient Identification
[--- LOCATION begin
PV1	Alarm Location
]	--- LOCATION end
]	--- PATIENT end
{	--- ALARM_IDENTIFICATION begin
[ORC]	Alarm Common
OBR	Alarm Identification
[{	--- ALARM_OBSERVATION begin
{OBX}	Alarm observation relative to OBR
{ [NTE] }	Notes and Comments
}]	--- ALARM_OBSERVATION end
}	--- ALARM_IDENTIFICATION end
}	--- ALARM end

If a single message contains multiple alarms for a given patient there must be an OBR preceding each group of OBX segments.

415 3.Y.4.1.3 Trigger Events

The AR has arrived at an event which may be an alarm and sends it to the AM.

3.Y.4.1.4 Message Semantics

<detailed description of the meaning of the transaction including any IHE specific clarifications of the message format, attributes, etc.>

420 **3.Y.4.1.5 Expected Actions**

The AM may or may not send an Alarm Dissemination to the AC and optionally sends Alarm Status to the AR based upon the Subscribe to Alarm Status option in the transaction.

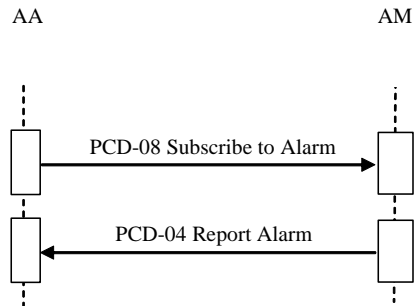
425 HL7 ACK from the Alarm Manager (AM) actor back to the Alarm Reporter (AR) actor is used to communicate that the Alarm Manager (AM) actor has received the Report Alarm [PCD-04] transaction from the Alarm Reporter (AR) actor. The Report Alarm [PCD-04] is asynchronous to Report Dissemination Alarm Status [PCD-07] transactions by an indeterminate amount of time. HL7 ACK is therefore not used to report dissemination status of the alarm as it would leave the Alarm Reporter (AR) actor awaiting HL7 ACK receipt for an indeterminate amount of time. Status updates as to the dissemination of the alarm are optional and are communicated
430 using the Report Alarm Status [PCD-05] transaction from the Alarm Manager (AM) to the Alarm Reporter (AR).

3.Y.4.1.6 Security Considerations

This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

435

3.Y.4.2 AM reports alarm to AA



AM sends Report Alarm to AA as HL7 OBX message

440 **3.Y.4.2.3 Trigger Events**

The AM is responding to the AA in response to a Subscribe to Alarm Cache or Query for Alarm by the AA.

3.Y.4.2.4 Message Semantics

3.Y.4.2.4.1 HL7 Conformance Statement

445 The conformance statement for this interaction described below is adapted from HL7 2.5.

Publication ID:	R01
Type:	Unsolicited
Publication Name:	IHEPCD-04ReportAlarm
Trigger:	None
Mode:	Immediate
Response:	ORU^R01^ORU_R01
Characteristics:	Sends defined alarm data
Purpose:	Report Alarm from AM to AA
Based on Segment Pattern:	R01

3.Y.4.2.4.1 PCD-04 Report Alarm (ORU^R01^ORU_R01) static definition

The PCD-04 Report Alarm message is used to communicate ACM data

From an Alarm Reporter (AR) to Alarm Manager (AM)

450 From Alarm Manager (AM) to Alarm Archiver (AA)

Common HL7 segments are defined in Appendix B Common Message Segments.

Device Technical Framework and Appendix C Common Data Types.

Table 1 ORU^R01^ORU_R01 static definition

ORU^R01^ORU_R01	ORU Message	Usage	Card.	Section Ref
MSH	Message Header Segment	R	[1..1]	2.15.9
PID	Patient Identification Segment	CE	[1..1]	3.4.2
PV1	Patient Visit Segment	CD	[1..1]	3.4.3
[ORC]	Common Order Segment	O	[1..1]	4.5.1
OBR	Observation Request Segment	R	[1..1]	7.4.1
OBX	Observation Result Segment	R	[1..n]	7.4.1
[NTE]	Notes and Comments Segment	O	[1..1]	2.5.10

455

3.Y.4.2.5 Expected Actions

AI receives Report Alarm and responds to requestor which initiated the request.

3.Y.4.2.6 Security Considerations

460 This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

3.Y+1 PCD-05 Report Alarm Status

This section corresponds to Transaction PCD-05 of the IHE Technical Framework. Transaction PCD-05 is used by the Alarm Manager (AM) actor to report alarm status updates to the Alarm Reporter (AR) actor.

465 3.Y+1.1 Scope

This transaction is used by the Alarm Manager (AM) to report one or more dissemination status updates to the Alarm Reporter.

3.Y+1.2 Use Case Roles



470 **Actor:** Alarm Manager (AM)

Role: Sends Report Alarm Status to Alarm Reporter (AR)

Actor: Alarm Reporter (AR)

Role: Receives Report Alarm Status from the Alarm Manager (AM)

3.Y+1.3 Referenced Standard

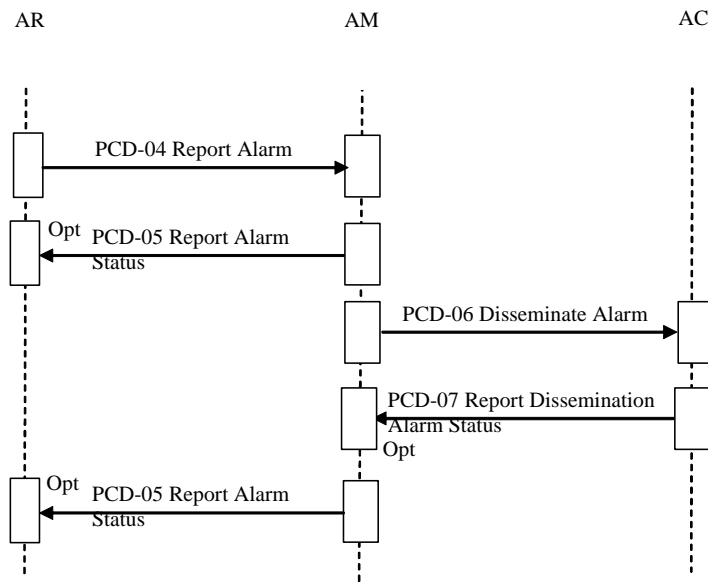
475 HL7 - Health Level 7 Version 2.5 Ch7 Observation Reporting

ISO/IEEE 11073-10201 Domain Information Model

ISO/IEEE 11073-10101 Nomenclature

3.Y+1.4 Interaction Diagrams

3.Y+1.4.1 AM status updates to AR



480

AM sends Report Alarm Status to AR as HL7 OBX message

3.Y+1.4.1.2 Trigger Events

485 The AM has determined either through configuration and contextual data driven decision rules or through receipt of Dissemination Status from the Alarm Communicator that an alarm status update needs to be sent to the AR.

AM internal trigger events include the following.

- Accept (not specified, correct)
- Reject (not specified, nuisance but correct, false positive)
- Deliverable, had a mapped destination
- 490 Queued to communications

3.Y+1.4.1.3 Message Semantics

3.Y+1.4.1.1 HL7 Conformance Statement

The conformance statement for this interaction described below is adapted from HL7 2.5.

Publication ID:	R01
Type:	Unsolicited
Publication Name:	IHEPCD-05ReportAlarmStatus
Trigger:	None
Mode:	Immediate
Response:	ORU^R01^ORU_R01
Characteristics:	Sends alarm status data
Purpose:	Provide alarm status from AM to AR
Based on Segment Pattern:	R01

495 3.Y+1.4.1.1 PCD-05 Report Alarm Status (ORU^R01^ORU_R01) static definition

The PCD-05 Report Alarm Status message is used to communicate ACM messaging status from an Alarm Manager (AM) to Alarm Reporter (AR)

Common HL7 segments are defined in Appendix B Common Message Segments.

Device Technical Framework and Appendix C Common Data Types.

500 **Table 1 ORU^R01^ORU_R01 static definition**

ORU^R01^ORU_R01	ORU Message	Usage	Card.	Section Ref
MSH	Message Header Segment	R	[1..1]	2.15.9
PID	Patient Identification Segment	CE	[1..1]	3.4.2
PV1	Patient Visit Segment	CD	[1..1]	3.4.3
[ORC]	Common Order	O	[1..1]	4.5.1

	Segment			
OBR	Observation Request Segment	R	[1..1]	7.4.1
OBX	Observation Result Segment	R	[1..n]	7.4.1
[NTE]	Notes and Comments Segment	O	[1..1]	2.5.10

3.Y+1.4.1.4 Expected Actions

AR takes appropriate action based upon alarm status update.

3.Y+1.4.1.5 Security Considerations

- 505 This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

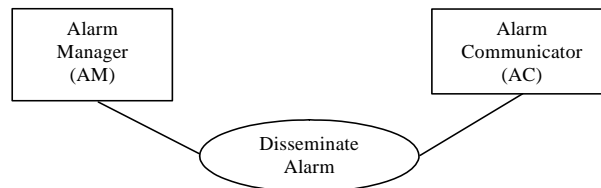
3.Y+2 PCD-06 Disseminate Alarm

- 510 This section corresponds to Transaction PCD-06 of the IHE Technical Framework. Transaction PCD-06 is used by the Alarm Manager (AM) actor to disseminate alarms to the Alarm Communicator (AC) actor.

3.Y+2.1 Scope

This transaction is used by Alarm Manager (AM) to disseminate the alarm to the Alarm Communicator (AC).

3.Y+2.2 Use Case Roles



515

Actor: Alarm Manager (AM)

Role: Sends Disseminate Alarm to Alarm Cmmunicator (AC)

Actor: Alarm Communicator (AC)

Role: Receives Disseminate Alarm from the Alarm Manager (AM)

520 **3.Y+2.3 Referenced Standard**

The communication protocol is vendor dependent and potentially proprietary. The communicated data items are in scope for this profile. The protocol and communication endpoint device presentation are not in scope for this profile.

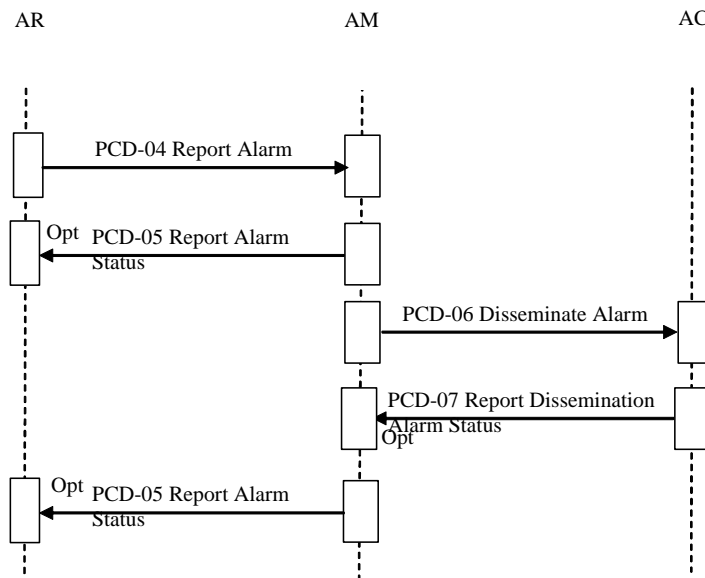
525 While alarm related data items available to the AM is specified in this profile the ability of individual communication devices to communicate, display, or respond to those data items are dependant upon the product capabilities and site specific configuration of the AC actor, the communication device, and the available communication infrastructure.

ISO/IEEE 11073-10201 Domain Information Model

ISO/IEEE 11073-10101 Nomenclature

530 **3.Y+2.4 Interaction Diagrams**

3.Y+2.4.1 AM disseminate alarm to AC



AM sends Disseminate Alarm to AC. The protocol is AC vendor dependent.

3.Y+2.4.1.1 HL7 Conformance Statement

535 The communication protocol is vendor dependent. There is no specified HL7 conformance.

3.Y+2.4.1.2 PCD-06 Disseminate Alarm static definition

The PCD-06 Disseminate Alarm message is used to communicate ACM data from an Alarm Manager (AM) to the Alarm Communicator (AC)

3.Y+2.4.1.3 Trigger Events

540 The AM has determined that an alarm needs to be disseminated and so sends it to the AC.

3.Y+2.4.1.4 Message Semantics

This message communicates alarms to communication endpoint devices.

545 The table below lists the data items and their optionality. All of these data items are contained within the SMTP e-mail item text object as a comma-separated list of double-quote-enclosed text fields in the order shown in the table. That is, the identity of the data items is indicated by their position in the sequence of comma-separated fields. An empty field is indicated by two separators (commas) in succession with no text in between (the quotes may be omitted in the case of an empty field). All separators after the last field containing a value are optional.

Table 1 PCD-06 static definition

PCD-06	Fields	Usage	Card.
Alarm_Location	Alarm associated location	CE	[1..1]
Alarm_Patient	Patient Identification	CE	[1..1]
Alarm_Text	Textual alarm identification	R	[1..1]
Alarm_Identifier	Alarm unique identifier	O	[1..1]
Alarm_Callback	Call back connection information	O	[1..1]
Alarm_Reference	URL or application link potentially containing alarm or patient contextual information	O	[1..1]
Alarm_Comment	Notes and Comments associated with alarm	O	[1..1]
Alarm_Evidentiary_Data	Evidentiary data associated with alarm, e.g. waveform data graphic	O	[1..1]

550

3.Y+2.4.1.5 Expected Actions

AC sends alarm to endpoint.

3.Y+2.4.1.6 Security Considerations

555 This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

3.Y+3 PCD-07 Report Dissemination Alarm Status

This section corresponds to Transaction PCD-07 of the IHE Technical Framework. Transaction PCD-07 is used by the Alarm Communicator actor.

3.Y+3.1 Scope

560 This transaction is used by Alarm Communicator to report one or more dissemination status updates to the Alarm Manager (AM).

3.Y+3.2 Use Case Roles



Actor: Alarm Communicator (AC)

565 **Role:** Sends Dissemination Status to the Alarm Manager (AM)

Actor: Alarm Manager (AM)

Role: Receives Dissemination Status from the Alarm Communicator (AC)

3.Y+3.3 Referenced Standard

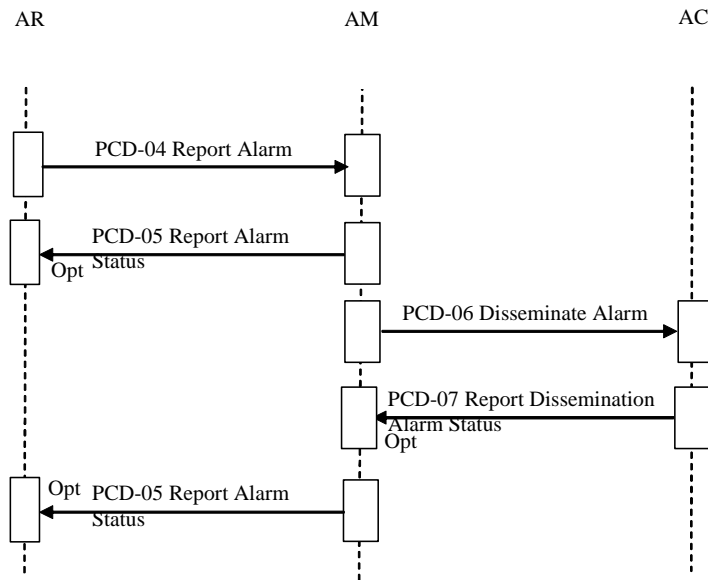
570 The communication protocol is AC vendor dependent and potentially proprietary. The communicated data items are in scope for this profile. The protocol and communication endpoint device presentation are not in scope for this profile.

ISO/IEEE 11073-10201 Domain Information Model

ISO/IEEE 11073-10101 Nomenclature

3.Y+3.4 Interaction Diagrams

575 3.Y+3.4.1 AC status updates to AM



AC sends Dissemination Status to AM. The protocol is AC vendor dependent.

3.Y+3.4.1.3 Trigger Events

The AC has determined a dissemination status update needs to be sent to the AM.

580 The following table lists the results of the dissemination from the AC back to the AM for optional relay back to the AR or AI. The required Communication Status Enumerations are indicated.

Usage	Communication Status Enumeration
R	Accepted by communications (accepted by SMTP gateway)
O	Undeliverable to endpoint
O	Delivered to endpoint
O	Read at endpoint
O	Accepted by endpoint
O	Accepted by endpoint as true positive
O	Accepted by endpoint as true positive however not clinically relevant
O	Accepted by endpoint as false positive
O	Rejected by endpoint
O	Cancelled by endpoint

O	Cancelled by other than endpoint
O	Callback start at endpoint
O	Callback end at endpoint

585 A single alarm may go through multiple communications status updates as the alarm is communicated to the endpoint user or application. Which of the status updates are possible is AC actor and endpoint implementation dependent. Some endpoint devices are output only, such as marquee signs, some are one-way only such as pagers. Some pagers and services offer transmission confirmation. More advanced communications endpoints offer two-way capabilities allowing the operator of the endpoint to accept or cancel the alarm.

590 Detailed reason for status can optionally be included to encompass the concept of presence to allow for messages not making it to the endpoint or being rejected by the endpoint due to a presence state such as offline, busy, or do not disturb.

3.Y+3.4.1.4 Message Semantics

595 This message is used to communicate status updates on the communication of an alarm to endpoints.

HL7 Conformance Statement

The communication protocol is vendor dependent. There is no specified HL7 conformance.

PCD-07 Report Dissemination Alarm Status static definition

600 The PCD-07 Dissemination Status message is used to communicate ACM messaging status from an Alarm Communicator (AC) to Alarm Manager (AM)

The message communication protocol and presentation are outside the scope of the profile.

The table below lists the data items and their optionality.

605

Table 1 PCD-07 static definition

PCD-07	ORU Message	Usage	Card.
Alarm_Identifier	Alarm unique identifier (see PCD-06)	R	[1..1]
Alarm_Status	Communication Status Enumeration item	R	[1..1]

3.Y+3.4.1.5 Expected Actions

The AM may or may not send the optional Report Alarm Status to the AR as a result of AM receipt of this message.

610 **3.Y+3.4.1.6 Security Considerations**

This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

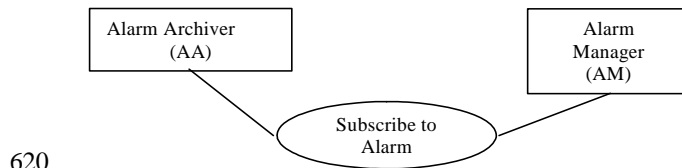
3.Y+4 PCD-08 Subscribe to Alarm

615 This section corresponds to Transaction PCD-08 of the IHE Technical Framework. Transaction PCD-08 is used by the Alarm Archiver (AA) actor.

3.Y+4.1 Scope

This transaction is used by the Alarm Archiver (AA) actor to request subscription to alarms from the Alarm Manager (AM) actor.

3.Y+4.2 Use Case Roles



Actor: Alarm Archiver (AA)

Role: Sends Subscribe to Alarm to the Alarm Manager (AM)

Actor: Alarm Manager (AM)

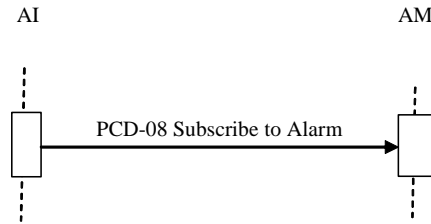
Role: Receives Subscribe to Alarm from Alarm Archiver (AA)

625 **3.Y+4.3 Referenced Standard**

HL7 - Health Level 7 Version 2.5 Ch5 Query and Ch7 Observation Reporting
ISO/IEEE 11073-10201 Domain Information Model
ISO/IEEE 11073-10101 Nomenclature

3.Y+4.4 Interaction Diagrams

630 **3.Y+4.4.1 AA subscribes to AM alarm**



AI sends Subscribe to Alarm to AM as HL7 QSB message

Trigger Events

When AA needs to receive alarms from AM it issues a Subscribe to Alarm.

635 **3.Y+4.4.1.4 Message Semantics**

HL7 Conformance Statement

The conformance statement for this intraction described below is adapted from HL7 2.5.

Publication ID:	QSB
Type:	Unsolicited
Publication Name:	IHEPCD-08SubscribeToAlarm
Trigger:	None
Mode:	Immediate
Response:	ORU^R01^ORU_R01
Characteristics:	Sends alarm subscription request
Purpose:	AA subscription to AM alarm
Based on Segment Pattern:	QSB

PCD-08 Subscribe to Alarm (QSB^Z03^QSB_Q16) static definition

640 The PCD-08 Subscribe to Alarm message is used to subscribe to AM alarms entering the alarm store of the AM from an Alarm Archiver (AA) to Alarm Manager (AM)

Common HL7 segments are defined in Appendix B Common Message Segments.

Device Technical Framework and Appendix C Common Data Types.

645

Table 1 QSB^Z03^QSB_Q16 static definition

ORU^R01^ORU_R01	ORU Message	Usage	Card.	Section Ref
MSH	Message Header Segment	R	[1..1]	2.15.9
PID	Patient Identification Segment	CE	[1..1]	3.4.2
PV1	Patient Visit Segment	CD	[1..1]	3.4.3
[ORC]	Common Order Segment	O	[1..1]	4.5.1
OBR	Observation Request Segment	R	[1..1]	7.4.1
OBX	Observation Result Segment	R	[1..n]	7.4.1
[NTE]	Notes and Comments Segment	O	[1..1]	2.5.10

3.Y+4.4.1.5 Expected Actions

The AM will prepare itself to send Report Alarm messages to the AI based upon the subscription.

3.Y+4.4.1.6 Security Considerations

650 This profile does not impose specific requirements for authentication, encryption, or auditing, leaving these matters to site-specific policy or agreement.

3.Z Common Message Segments

655 The following descriptions rely on IHE PCD Technical Framework Appendix B Common Message Segments and A.1 Mapping ISO/IEEE 11073 Domain Information Model to HL7. All provisions of those referenced sections should be assumed to apply also to Alarm Communications Management. The additional information in this document supplements and comments on those referenced sections with specific reference to the communication of alarms.

3.Z.1 PID Patient Identification Segment

660 This segment is required to be present and is populated with data used to identify the patient associated with the alarm in the case where the identity is available to the Alarm Source system. If the patient identification is not present the alarm may be location source based per ACM use case A1 in which case the PV1 segment identifies the location associated with the alarm. Additional information may be present to more unambiguously identify the patient.

665

Table 1 HL7 Attribute Table – PID – Patient Identification

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
3	250	CX	O	Y		00106	Patient Identifier List
5	250	XPN	O	Y		00108	Patient name
7	26	TSO	O			00110	Date/Time of Birth
8	1	IS	O			00111	Administrative Sex

PID-3 Patient Identifier List (CX) 00106**PID-5 Patient Name (XPN) 00108****PID-7 Date/Time of Birth (TSO) 00110**670 **PID-8 Administrative Sex (IS) 00111**

This is the list of fields used to identify the patient in the system and which may be included in displays on the endpoint device to allow the user to determine the patient to which the alarm applies.

3.Z.2 PV1 Patient Visit Segment

675 This segment is used to identify a patient location associated with the alarm. Real Time Location Services (RTL) equipment or personnel location information is not passed in this segment. It is passed from the AR to the AM via the OBX segment.

680 If the Patient Identification (PID) segment is present in the alarm data and it contains an identified patient as in ACM use case A2 resolve patient location from a more contemporary information source than this segment.

Table 1 HL7 Attribute Table – PV1 – Patient Visit

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
3	80	PL	O			00133	Assigned Patient Location

PV1-3 Assigned Patient Location (PL) 00133

685 This field contains the location associated with the alarm. This may not be the current location of the alarm related patient. It is typically a fixed location as in that associated with a patient station of a nurse call system.

3.Z.3 ORC Observation Control Segment

690 This segment is optionally used to convey order request information for alarms involving notification of order request. In addition, this segment may allow the association of the completed observation results reported in OBX segments with a particular previous order request.

Table 1 HL7 Attribute Table – ORC – Observation Control

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
2	22	EI	O			00216	Placer Order Number
12	250	XCN	O	Y		00226	Ordering Provider
14	250	XTN	O	Y/2		00228	Call Back Phone Number

ORC-2 Placer Order Number (EI) 00216

This field is the placer application's order number.

695 **ORC-12 Ordering Provider (XCN) 00226**

This field contains the identity of the person who is responsible for creating the request (i.e., ordering physician). ORC-12-ordering provider is the same as OBR-16-ordering provider. If the ordering provider is not present in the ORC, it must be present in the associated OBR. This is particularly important when results are transmitted in an ORU message. In this case, the ORC is not required and the identifying filler order number must be present in the OBR segments.

700

ORC-14 Call Back Phone Number (XTN) 00228

This field contains the telephone number to call for clarification of a request or other information regarding the order. ORC-14-call back phone number is the same as OBR-17-order callback phone number.

705 **3.Z.4 OBR Observation Request Segment****Table 1 HL7 Attribute Table – OBR – Observation Result**

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
2	22	EI	O			00216	Placer Order Number
3	22	EI	R			00217	Filler Order Number
4	250	CE	R			00238	Universal Service Identifier
17	250	XTN	O	Y/2		00250	Order Callback Phone Number

OBR-2 Placer Order Number (EI) 00216

This field identifies an individual order (e.g., OBR) and is the same as ORC-2.

OBR-3 Filler Order Number (EI) 00217

710 This field serves as the unique identifier for the alarm. It is assigned by the Alarm Source and is used by system actors to associate all messages from all actors that pertain to a particular alarm throughout the history of the alarm. So the same value of OBR-3 will be sent by the Alarm Source in the messages concerning the start, end, continuation of the alarm, and will also be used in status messages from other actors concerning that alarm. It may consist of a unique identifier of the device such as an EUI-64 and a serial number or time stamp for the alarm, but other forms that are unique among alarms sourced by a particular Alarm Reporter are acceptable. An order number sourced by the filling application may be used in the case of an order and in this case must also serve to uniquely identify the related alarm events.

715

OBR-4 Universal Service Identifier (CE) 00238

- 720 This field contains the identifier code for the source of the alarm or the requested observation/test/battery. See the IHE Patient Care Device Technical Framework description of the DEC profile transactions for further information (Volume 2, Section B.7 OBR Observation Request Segment, OBR-4 Universal Service ID).

OBR-17 Order Callback Phone Number (XTN) 00250

- 725 This field is the telephone number for reporting a status or a result using the standard format with extension and/or beeper number when applicable. This can be used to pass the nurse call system patient station telephone call back information to the caregiver.

3.Z.5 OBX Observation Result Segment

- 730 Unlike a typical physiological measurement, which has a few key attributes that in the transactions of the DEC profile have been fitted readily into a single OBX segment, an alarm has multiple heterogeneous key attributes such as alarm source, alarm priority, and alarm phase which are called facets in this discussion, and which are encoded in multiple OBX segments hierarchically nested under a single OBR segment (all OBX segments under the OBR must pertain to a single alarm). The different OBX segments pertaining to a single alarm are distinguished by OBX-4 Observation Sub-ID, which uses a dotted notation to identify the specific source within an instrument, and for alarms, the facet represented by a particular OBX segment. This dotted notation is based on the DEC profile, which in turn is based on a suggestion in the HL7 version 2.5 specification (see section 7.4.2.4 "Observation Sub-ID").

- 740 Most alarm message characteristics are identified by combination of OBX-3 Observation Identifier and OBX-4 Observation Sub-ID and contain a value in OBX-5 Observation Value. Alarm Priority and Alarm Source are given in the OBX-8 Abnormal Flags field of the facet 1 OBX segment. They should not be repeated on subsequent OBX segments for other facets on the principle that data items should have one best placement and unneeded repetition invites inconsistency.

- 745 The Filler Order Number of the OBR segment uniquely identifies the alarm instance and must be the same for all messages pertaining to that alarm (start and end state transitions, continuation, etc.) as well as messages back from the Alarm Manager (AM) actor that pertain to the particular alarm instance (replies, acknowledgements, etc.).

- 750 Since the information to be conveyed in this profile has much in common with clinical measurements already covered by the existing profile, only extensions and other necessary differences will be described here. For all other details, the DEC profile is to be followed.

Semantics

The intention is to transmit transparently the key attributes of an event relevant to secondary notification of caregivers. These include:

- 755 the identity of the alarm
- whether its source is physiological or technical
- its priority (severity)
- the state transition or persistent state that is being communicated by the current message.

760 The representation relies on ISO/IEEE 11073 nomenclature and concepts for alarms, which in turn are consistent with IEC 60601-1-8 alarm nomenclature and concepts.

Table 1 HL7 Attribute Table – OBX – Observation Result

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
2	2	ID	C		0125	00570	Value Type
3	250	CE	R			00571	Observation Identifier
4	20	ST	C			00572	Observation Sub-ID
5	99999	varies	C	Y/2		00573	Observation Value
6	250	CE	O			00574	Units
7	60	ST	O			00575	References Range
8	5	IS	O	Y	0078	00576	Abnormal Flags
14	26	TS	CE				Observation Date/Time
18	22	EI	O	Y		01479	Equipment Instance Identifier

OBX-2 Value Type (ID) 00570

This field contains the format of the observation value in the OBX.

765 OBX-3 Observation Identifier (CE) 00571

This field contains a unique identifier for the kind of measurement or device-dependent data that is given in OBX-5 Observation Value of the current segment. It shall preferably be drawn from the MDC nomenclature, or, failing that, LOINC. Terms not in the MDC nomenclature should be submitted to ISO/IEEE 11073 committee for possible standardization. Pending standardization, on a temporary basis by site agreement, agreed-on numeric codes and identifier strings in the range reserved in the standard for private codes may be used if necessary.

770

OBX-4 Observation Sub-ID (ST) 00572

This field is used to distinguish between multiple OBX segments with the same observation ID organized under one OBR. The sub-identifier is also used to group related components. The scheme used for alarms is an extension of that used in the DEC profile transactions for measurements, which should be studied by those planning to use the Alarm Communication Management supplement. It uses a dotted notation, where the elements are numbers distinguishing the hierarchical containment levels of different measurements and different

775

780 technical subsystems with the ISO/IEE 11073 Domain Information Model of the patient care device, that is, <MDS>.<VMD>.<CHANNEL>.<METRIC >.

In the Alarm Communications Management profile, a fifth element, <FACET>, is added to distinguish the additional facets of an alarm, such as Alarm State, Phase, Inactivation State, and Evidentiary Data, that must be conveyed in associated additional OBX segments beyond the first.

785

<FACET> value	Facet name	Comments
1	Event identification	This facet specifies the MDC event code for the alarm
2	Source identification	Identifies the physiological measurement or technical source responsible for the alarm.
3	Event phase	Whether the stimulus for the message is the beginning, end, or some other state or state transition of the alarm.
4	Alarm state	Indicates the state of the underlying alarm condition at the patient care device: inactive active latched (no longer active but persisted to allow caregivers to be notified of transient but significant events)
5	Inactivation State	Optional. Indicates whether visual or aural indications at the patient care device are inactivated.
6	Real-time location	Optional. Real time location data concerning the patient, if available. Applicable where there are technical means to determine the current location of the patient, as distinct from the administratively assigned location that may be present in segment PV1. The Observation Value for this facet is in system-dependent format, defined by site-specific agreement.
7	Evidentiary data	Optional. Real time waveform snippet if available.

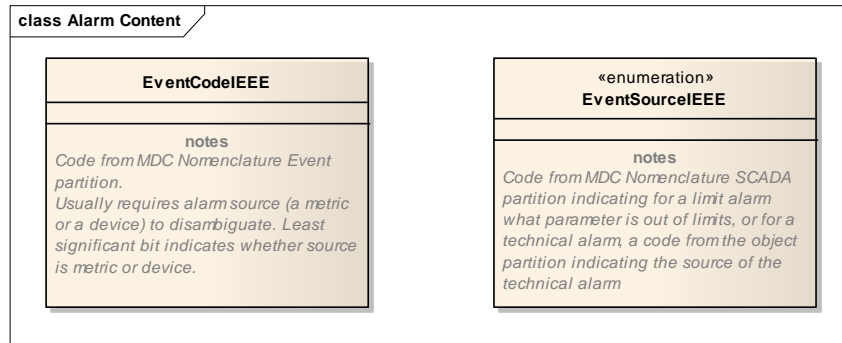
OBX-5 Observation Value (varies) 00573

790 This field contains the value observed by the alarm reporter. Its meaning differs according to the facet identified in OBX-4 Sub-ID (see above). The following sections give the details for each facet.

795 In all cases, OBX-2-value type contains the data type for this field according to which observation value is formatted. It is not a required field because some systems will report only the abnormal flags for the observation (OBX-8). The length of the observation field is variable, depending upon OBX-3-value type. This field may repeat for multipart, single answer results with appropriate data types, e.g., CE, TX, and FT data types.

Facet 1. Event Identification

The identity of alarms is represented by event codes from ISO/IEEE 11073-10101 nomenclature for alerts (Block E).



800

Facet 2. Source identification

For an event code corresponding with a metric alarm, this segment identifies the particular measurement that is the source of the alarm by its MDC nomenclature code in OBX-3

805 Observation Identifier. If it has a numeric value, it shall be in OBX-5 Observation Value, and if available the alarm range set in the device will be encoded in OBX-7 Reference Rang

For a technical alarm, this facet specifies the subsystem that is the source of the event by its MDC object code in OBX-5 Observation Value, and by its dotted sub-ID notation according to the DEC specification for OBX-4 Observation Sub-ID.

810 **Facet 3. Event Phase**

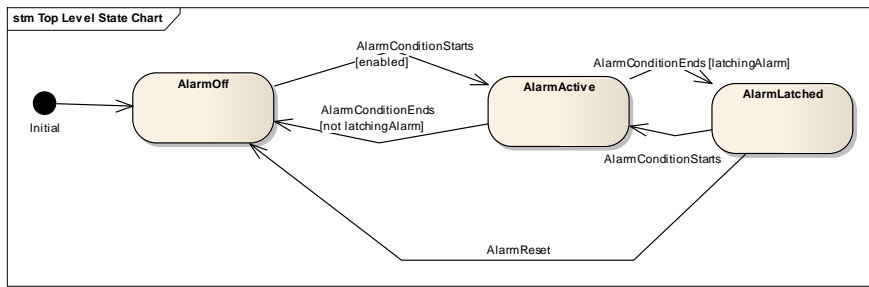
Contains the current phase of the alarm from the EventCurrentPhase enumeration

- tpoint |
- start |
- continue |
- 815 end |
- update |
- escalate |
- de-escalate |
- reset

820 The EventCurrentPhase identifies the state transition or state that the current alarm message is indicating: a *tpoint* event is a time point event with no duration, a *continue* event indicates that this message does not represent a state transition but rather reports the continuation of an event that started at some previous time. An *update* indicates a change other than a state transition in a previously reported alarm, such as a further change in an out-of-limit metric. The phases *escalate* and *de-escalate* represent changes in alarm priority as assessed by the patient care device.

825

State transitions



A message representing an alarm is sent aperiodically, when the alarm undergoes a state transition that may be significant for secondary notification (alarm start, alarm end, escalation or de-escalation of priority as evaluated by the alarm source patient care device, change of description).

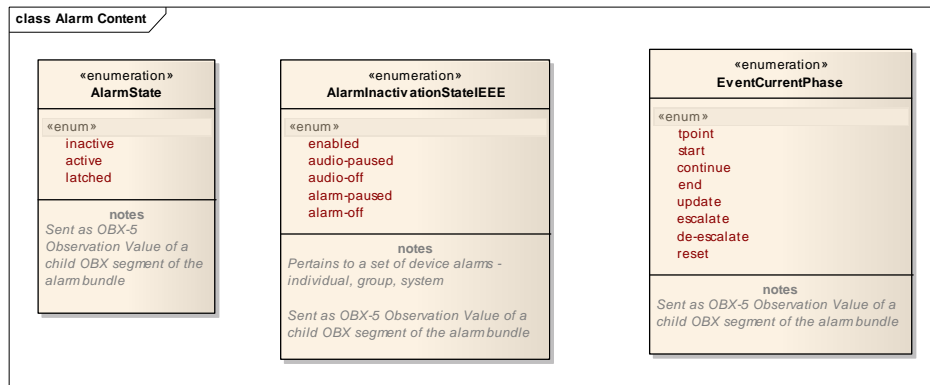
830

By site agreement, messages representing current state of alarms may optionally also be sent at other times, as for example on a periodic timed basis.

Facet 4. Alarm current state

835

The value of the AlarmState facet reflects whether the alarm condition currently exists (inactive or active) or if the alarm condition formerly existed, does not now exist, but is “latched” or held by the patient care device so that caregivers may be notified of transient but significant conditions.



840 **Facet 5. Inactivation state**

The AlarmInactivationState reflects the current state of the visual and aural alarm indications at the patient care device sourcing the alarm.

This may be empty if unavailable or not wanted. May contain the value 'enabled', meaning that both visual and aural alarm indications are enabled at the device. May be repeated, to indicate separately the state of visual indications at the device by including zero or one of the values:

alarm-paused
alarm-off

and zero or one of the values:

850 audio-paused
audio-off

If neither of 'alarm-paused' or 'alarm-off' is included, the visual alarm indication is assumed to be enabled regardless of whether 'enabled' is also present.

If neither of 'audio-paused' or 'audio-off' is included, the aural alarm indication is assumed to be enabled regardless of whether 'enabled' is also present.

855 **Facet 6. Real-time location**

Optional. Real time location data concerning the patient, if available.

860 Applicable where there are technical means to determine the current location of the patient, as distinct from the administratively assigned location that may be present in segment PV1. The Observation Value for this facet is in system-dependent format, defined by site-specific agreement.

Facet 7. Evidentiary data

865 This facet encodes an array of real-time measurements typically representing a physiological waveform meant to be rendered at the endpoint device to assist the caregiver in assessing the condition of the patient that the alarm is for. It is intended to include a normative description of a data format in a future version of this document. At this time, any use of this facet must be by site-specific agreement.

OBX-6 Units (CE) 00574

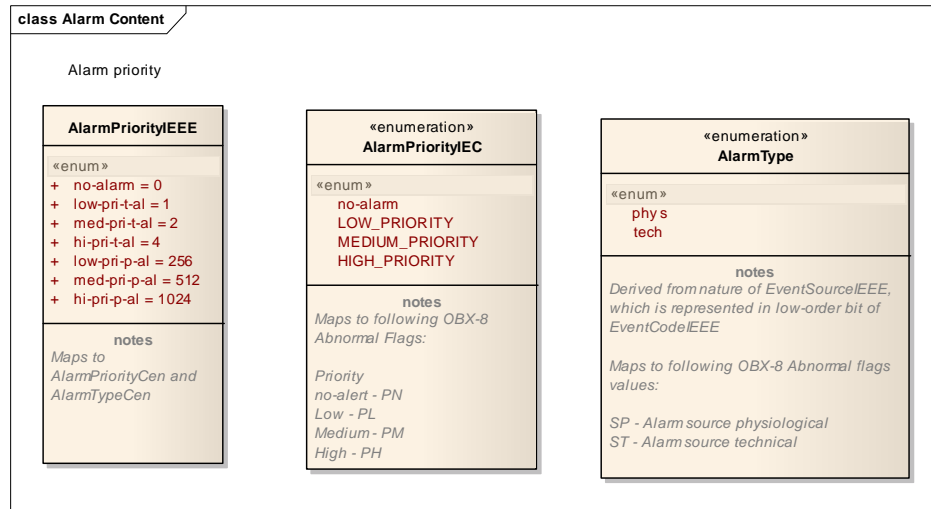
This field specifies the units associated with the observed value.

OBX-7 References Range (ST) 00575

870 The range of values for Observation Value. The Alarm Manager (AM) actor does not use this field to analyze or indicate whether an alarm is due to an abnormal, or critical value in the Observation Value. Instead the Abnormal Flags field is used.

OBX-8 Abnormal Flags (IS) 00576

875 This field may be repeated and can contain zero or more abbreviations indicating different facets of the abnormality of a result, including the type of abnormality (using predefined abbreviations from the table of values in the HL7 standard), and also values from the tables below alarm priority and whether the alarm is physiological or technical (AlarmType).



880

AlarmPriorityIEEE is displayed for reference, to show the correspondence between the combined encoding for priority and source used in ISO/IEEE-1073 and the separate encodings used in this Profile.

885 The following abbreviations in the OBX-8 Abnormality Flags field can be used to indicate the type of abnormality, its priority as indicated by the source patient care device, and whether it is a physiological alarm based on monitoring observations from the patient, or a technical alert indicating a condition of the patient care device and not the patient which nonetheless requires caregiver action.

Abnormality Type	Abbreviation
Normal, not abnormal	N
Below low normal	L
Below lower panic limits	LL
Above high normal	H
Above higher panic limits	HH
Abnormal (for non-numeric results)	A

890

Alarm Priority	Abbreviation
no-alarm	PN

low priority	PL
medium priority	PM
high priority	PH

Alarm Source	Abbreviation
physiological	SP
technical	ST

This is a repeatable field and values from the above table may be combined by entering them as repetitions of the field, for example, a field value of 'H~PH~SP' would signify a physiological measurement with an abnormally high value, constituting a high priority alarm condition.

895 **OBX-14 Observation Date/Time**

The OBX segment of the Source Identification facet shall populate this field with the timestamp of the event transition this alarm represents (for example, the start time for an alarm start message, the end time for an alarm end message, and so forth). This is to be distinguished from the time the message was sent, which is carried in OBR-7.

900 **OBX-18 Equipment Instance Identifier (EI) 01479**

This field uniquely identifies the Alarm Reporter source of the alarm, preferably an EUI-64 (see base document).

3.Z.6 NTE Notes and Comment Segment

905 For indicated issues not addressed in information normative locations under agreement between the AR and AM actors. Site or system specific indications are optionally passed in this manner to the AM for dispatch decision making or through the AM to the AC to communications endpoints.

Table 1 HL7 Attribute Table – NTE – Notes and Comment

SEQ	LEN	DT	OPT	RP/#	TBL#	ITEM#	ELEMENT NAME
3	65536	FT	O	Y		00098	Comment

910 **NTE-3 Comment (FT) 00098**

This field contains the comment contained in the segment.

<Appendix letter> Example Messages

Alarm Communications Management Sample message

915

This is an example of a physiological limit alarm. It is a pulse rate high alarm. It started at 12:10:10.

920 ER7 version: (Editor Note: MDC codes to be assigned for EVENT_PHASE, ALARM_STATE and INACTIVATION_STATE)

MSH|||||20080515123100||ORU^R01^OR_R01|MSGID5432346754|P|2.5|||NE|AL||||IHE PCD
ORU-R01 208^HL7^2.16.840.1.113883.9.n.m^HL7

PID|||123456789||Doe^John^Joseph||19630415

925 PV1|||SICU^301^2|||||||||11772233

OBR|1||09780979a9879^PHILIPS^ABCD002343785379^EUI-
64|MDC_ALARM_EXAMPLE^Sample alarm^MDC^979879-
9879^Example^SNM3||20080515121000|||||800 555 2323

930 OBX|1|ST|196648^MDC_EVT_HI^MDC|1.1.1.1|PLETH PULSE
HIGH|||H~PM~SP|||||20050515121010||||CD12345^ORIGatewayInc ICU-
04^AECF114477885323^EUI-64|20080515121000

OBX|2|NM|149538^MDC_PLETH_PULS_RATE^MDC|1.1.1.2|160|264896^MDC_DIM_PU
LS_PER_MIN^MDC|40-
140|H~PM~SP|||||20080515121000|||||264896^MDC_UPEXT_FINGER^MDC

935 OBX|3|ST|EVENT_PHASE|1.1.1.1.3|start

OBX|4|ST|ALARM_STATE|1.1.1.1.4|active

OBX|5|ST|INACTIVATION_STATE|1.1.1.1.5|audio-paused

xml version:

```
<?xml version="1.0" encoding="UTF-8"?>
940 <ORU_R01>
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      <MSH.7>
          <TS.1>20080515123100</TS.1>
      </MSH.7>
945 <MSH.9>
          <MSG.1>ORU</MSG.1>
          <MSG.2>R01</MSG.2>
          <MSG.3>OR_R01</MSG.3>
      </MSH.9>
950 <MSH.10>MSGID5432346754</MSH.10>
      <MSH.11>
          <PT.1>P</PT.1>
      </MSH.11>
      <MSH.12>
955 <VID.1>2.5</VID.1>
      </MSH.12>
      <MSH.15>NE</MSH.15>
      <MSH.16>AL</MSH.16>
      <MSH.21>
960 <EI.1>IHE PCD ORU-R01 208</EI.1>
          <EI.2>HL7</EI.2>
          <EI.3>2.16.840.1.113883.9.n.m</EI.3>
          <EI.4>HL7</EI.4>
      </MSH.21>
965 </MSH>
<ORU_R01.PATIENT_RESULT>
<ORU_R01.PATIENT>
  <PID>
```

```

    <PID.3>
970     <CX.1>123456789</CX.1>
    </PID.3>
    <PID.5>
        <XPN.1>
            <FN.1>Doe</FN.1>
975     </XPN.1>
        <XPN.2>John</XPN.2>
        <XPN.3>Joseph</XPN.3>
    </PID.5>
    <PID.7>
980     <TS.1>19630415</TS.1>
    </PID.7>
    </PID>
<ORU_R01.VISIT>
    <PV1>
985     <PV1.3>
        <PL.1>SICU</PL.1>
        <PL.2>301</PL.2>
        <PL.3>2</PL.3>
    </PV1.3>
990     <PV1.19>
        <CX.1>11772233</CX.1>
    </PV1.19>
    </PV1>
</ORU_R01.VISIT>
995 </ORU_R01.PATIENT>
<ORU_R01.ORDER_OBSERVATION>
    <OBR>
        <OBR.1>1</OBR.1>
        <OBR.3>
1000     <EI.1>09780979a9879</EI.1>

```

<EI.2>PHILIPS</EI.2>
<EI.3>ABCD002343785379</EI.3>
<EI.4>EUI-64</EI.4>
</OBR.3>
1005 <OBR.4>
<CE.1>MDC_ALARM_EXAMPLE</CE.1>
<CE.2>Sample alarm</CE.2>
<CE.3>MDC</CE.3>
<CE.4>979879-9879</CE.4>
1010 <CE.5>Example</CE.5>
<CE.6>SNM3</CE.6>
</OBR.4>
<OBR.7>
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1015 </OBR.7>
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</OBR.17>
</OBR>
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<CE.3>MDC</CE.3>
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1030 <OBX.5>PLETH PULSE HIGH</OBX.5>
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<OBX.8>PM</OBX.8>

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1035     <OBX.8>SP</OBX.8>
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            <EI.1>CD12345</EI.1>
            <EI.2>ORIGatewayInc ICU-04</EI.2>
1040     <EI.3>AECF114477885323</EI.3>
            <EI.4>EUI-64</EI.4>
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        </OBX>
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        <OBX.2>NM</OBX.2>
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            <CE.2>MDC_PLETH_PULS_RATE</CE.2>
            <CE.3>MDC</CE.3>
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            <CE.2>MDC_DIM_PULS_PER_MIN</CE.2>
1060     <CE.3>MDC</CE.3>
        </OBX.6>
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        <OBX.8>H</OBX.8>
        <OBX.8>PM</OBX.8>

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</OBX.14>
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</OBX.20>
</OBX>

1075 <OBX>
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</OBX>
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1085 <OBX.1>4</OBX.1>
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</OBX>
<OBX>
<OBX.1>5</OBX.1>

1095 <OBX.2>ST</OBX.2>
<OBX.3>

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    <CE.1>INACTIVATION_STATE</CE.1>
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1100 <OBX.5>audio-paused</OBX.5>
    </OBX>
    <OBX>
    <OBX.1>6</OBX.1>
    <OBX.2>ST</OBX.2>
1105 <OBX.3>
    <CE.1>REAL_TIME_LOCATION</CE.1>
    </OBX.3>
    <OBX.4>1.1.1.1.6</OBX.4>
    </OBX>
1110 <OBX>
    <OBX.1>7</OBX.1>
    <OBX.2>ST</OBX.2>
    </OBX>
</ORU_R01.OBSERVATION>
1115 </ORU_R01.ORDER_OBSERVATION>
</ORU_R01.PATIENT_RESULT>
</ORU_R01>
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