

Integrating the Healthcare Enterprise



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**IHE Radiology  
Technical Framework Supplement**

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**Standardized Operational Log of Events  
(SOLE)**

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**Rev. 1.3 – Trial Implementation**

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**Please verify you have the most recent version of this document. See [here](#) for Trial Implementation and Final Text versions and [here](#) for Public Comment versions.**

## Foreword

30 his is a supplement to the IHE Radiology Technical Framework V21.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published for Trial Implementation on June 15, 2023 and may be available for testing at subsequent IHE Connectathons. The supplement may be amended based on the results of testing. Following successful testing it will be incorporated into the Radiology Technical Framework. Comments are invited and may be submitted at  
35 [https://www.ihe.net/Radiology\\_Public\\_Comments](https://www.ihe.net/Radiology_Public_Comments).

This supplement describes changes to the existing technical framework documents.

“Boxed” instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

<i>Amend Section X.X by the following:</i>
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40 Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text **~~bold strikethrough~~**. When entire new sections are added, introduce with editor’s instructions to “add new text” or similar, which for readability are not bolded or underlined.

45 General information about IHE can be found at [IHE.net](https://www.ihe.net).

Information about the IHE Radiology domain can be found at [IHE Domains](#).

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at [Profiles](#) and [IHE Process](#)

50 The current version of the Radiology Technical Framework can be found at [Radiology Technical Framework](#).

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## Introduction to This Supplement

140 This supplement adds a profile for the capture and retrieval of operational events. It adds a profile section to Volume 1, several actors and one new transaction for bulk transfer to Volume 2 and one new content module to Volume 3 to describe the event report format. It makes use of several transactions from the ITI Technical Framework.

## Open Issues and Questions

None

## Closed Issues

Number	Issue
1	<p>Should the transport be Syslog, as it is in ATNA?</p> <p><b>Conclusion: Syslog and ATNA compatibility remain the correct choice.</b></p> <p>There are many different transport technologies for event reporting. The IT and other industries have not standardized these well. Problem specific constraints (plus not-invented-here) have driven many variations. The profile proposes the use of Syslog, consistent with ATNA and allowing re-use of many systems that support ATNA and Syslog.</p> <ol style="list-style-type: none"> <li>Existing technologies in use for event logging</li> </ol> <p>The following are four examples of event report transport. These are all in widespread use. There are also some important proprietary logging systems in use for mobile devices.</p> <p><b>Syslog</b></p> <p>This protocol has reached standardization, and it's what DICOM and ATNA use. It is universally available for laptops and desktop systems. It has limited availability for mobile devices. Syslog transport has a variety of performance and failure mode characteristics. These are probably acceptable but need to be recognized. They have been acceptable for other audit logs. Syslog limitations that may matter are:</p> <ol style="list-style-type: none"> <li>It does not guarantee delivery. TLS connection failures may result in truncated or lost messages. (These are quite rare.) It is the event source responsibility to manage buffering and re-transmission in the event of connection losses.</li> <li>The overhead per message is low, but a connection must be maintained. This is primarily a concern for mobile and battery powered devices that are event reporters. For mobile and battery powered devices a two step approach can be used. The first step is an internal journaling protocol defined and optimized for battery powered and disconnected operation. The second step is a network transmission from the internal log to a syslog server when power and network connectivity is available. Both Apple and Android have switched to a proprietary logging system, and away from Syslog, in part for this reason.</li> <li>Throughput is limited by network speed and buffering. This typically limits events to a few hundred to a few thousand per second. Higher volume event logs from large scale computing are one motivation for FLUME and similar high volume transports.</li> </ol> <p><b>Journalctl</b></p> <p>This is the emerging standard in Linux systems for internal journaling. Journalctl implementations include tools to send selections from the journalctl logs to external journaling systems by means of Syslog. There are various motivations for this new journaling system. The primary ones (plus of course not-invented-here) are throughput,</p>

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	<p>memory management, power management, and I/O management. An ordinary workstation will generate thousands of events per second during busy times such as system startup.</p> <p>They wanted to keep the performance impact low, and a network based system like syslog did not fit. There is no official standard organization responsible for this logging system. Journalctl is controlled by the Linux Foundation, and is designed to meet their goals:</p> <ul style="list-style-type: none"> <li>• High performance integration with the Linux kernel in both large and small configurations. This makes it much less interesting to the Windows or MacOS users. Android uses the Linux kernel, but Android vendors have not adopted Journalctl. The Linux Foundation is less interested in making adaptations to make journalctl easy to deploy in a Windows or Apple environment.</li> <li>• The expected environment is use in the warehouse, rack, desktop, or laptop environments. Power management is a secondary goal. The primary performance goal is dealing with the very high event loads that can occur in the larger systems and enabling high resolution event recording from a large number of internal sources. Another goal is operational independence between the internal journaling with journalctl and external export by network protocols.</li> <li>• Change management decisions are made internally within the Linux Foundation and Linux kernel developers. While this is a highly visible public process, it is not open to other participant feedback. As a result, some changes have been rather controversial or unexpected at times.</li> </ul> <p>Integration of Journalctl with Syslog, and some other protocols, is one of the design goals. Journalctl can be configured to transmit selected journalctl events to Syslog, either as they occur or later in batch mode. Journalctl defines an export format for media as well.</p> <p>Selection of Syslog by IHE does not interfere with the use of Journalctl by Linux based systems because they can be configured to export from the journalctl system to Syslog.</p> <p><b>No – because this is not likely to be used outside of Linux.</b></p> <p><b>Flume</b></p> <p>Flume is a logging system being pushed by the Apache foundation. Its primary target is massive continuous dataflows from many sources into a distributed database such as Hadoop for processing by distributed queries in environments like warehouse scale computing. An example use would be the collection of all the journalctl traffic for 10,000 nodes onto a distributed database of 100 database servers for analysis by 25 query/analysis nodes. It requires the Event Consumer to be a Hadoop server or equivalent. <b>It's a Java only library</b> at the moment, not a basic communication protocol, which requires the Event Reporter to be at least partially written in Java. (The functionality is a mix of Java processing in a standard library and communications elements, which makes it difficult to separate the library from the communications.)</p> <p><b>There is no official standard organization responsible for this logging system.</b></p> <p><b>Bitcoin/Blockchain</b></p> <p>It may feel odd to think of Bitcoin as a logging system, but what it records are events, mostly financial events like "A gave 2 bitcoins to B". It is dealing with an environment where there is massive mutual lack of trust, the transaction log must be redundant and survive extensive attacks, and the transaction volume is small.</p> <p>The performance tradeoffs have prioritized redundancy, survival of the logs in the face of corrupt and malicious nodes, while accepting high computational burdens and significant connectivity requirements on individual nodes. The protocol requires regular connectivity with many other network nodes.</p> <p><b>There is no official standard organization responsible for this logging system.</b></p> <p><b>The high computational burden and connectivity requirements make it unattractive.</b> <i>The survival of logs in the face of corrupt, defective, and malicious nodes is of value.</i> The computational cost and connectivity requirements would be a serious problem for mobile use. For other systems it might be feasible, but it is not clear that the risk of corrupt, defective, and malicious nodes is sufficient to justify the cost.</p> <p><b>Android/Ios (phone/tablet use)</b></p> <p>Both Google and Apple have switched from using Syslog to using internal logging methodologies where battery performance can be optimized. Neither chose journalctl. They have both a two step system where the first step is internal logging that is performed using the internal battery optimized method, and then a second step that extracts selected relevant events from that log and sends them to another network node using another method.</p>

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Number	Issue
	<p>This other method is typically able to send large blocks of event reports efficiently.</p> <p>There is no official standard organization responsible for these logging systems. Both are proprietary. Both have interesting capabilities that are closely integrated with the Android or IOS operating system environment. For example, Apple has an internal tagging and data concealing system to manage logs that contain private information and minimize the disclosure of private information to applications that process the logs.</p> <p><b>A bulk event transfer transaction is proposed to deal with this. [RAD-124]. This remains a risk issue until ITI confirms that they will use this.</b></p> <p><b>MQTT (Oasis)</b></p> <p>MQTT is a lightweight TCP transaction system designed for IoT type applications. From the MQTT web site: MQTT is a machine-to-machine (M2M)/"Internet of Things" connectivity protocol. It was designed as an extremely lightweight publish/subscribe messaging transport. It is useful for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. For example, it has been used in sensors communicating to a broker via satellite link, over occasional dial-up connections with healthcare providers, and in a range of home automation and small device scenarios.</p> <p>MQTT is standardized as an OASIS standard <a href="http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/os/mqtt-v3.1.1-os.pdf">http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/os/mqtt-v3.1.1-os.pdf</a></p>
2	<p>Are there additional events in SWIM that should be required in the profile? Are there other events that should be in the profile (and added to SWIM)?</p> <p><b>The intention is to harmonize additional events with SWIM.</b>  <i>Preliminary list selection done in F2F number one. See Section 6.3 (volume 3)</i>  <i>(17 Feb) "Critical Result discovered" added to the list.</i>  <i>(3 March) Additional events added during discussion</i>  <i>(9 May) Additional events added based on public comment feedback</i></p>
3	<p>Should a message encoding schema different than the DICOM Audit Schema be used?</p> <p><b>No - The profile assumes use of the DICOM Audit Schema so that ATNA tooling can be re-used.</b></p>
4	<p><i>Removed, editorial instructions not a comment issue</i></p>
5	<p>Should this profile add the RESTful POST of syslog messages that was proposed for ITI this year?</p> <p><b>Included for PC and decide then.</b>  <b>Feedback from PC: yes, include. Proceed with ITI discussions</b></p> <p>This supplement will be the starting point. The expectation is that it will be added to ITI based on experience. It wasn't ranked high enough to get resources in 2017 from ITI, and was thought small enough that perhaps a CP was the right approach rather than a supplement.</p> <p>This has two potential uses:</p> <ol style="list-style-type: none"> <li>5. A "push" mode for delivering a selection of reports from an Event Record Repository to an Event Consumer. Field experience with security audits is that there is often a need to deliver a subset of the events to a consumer for analysis. Defining this subset in terms of queries can be very complex. It is often much easier for the Repository to select the set of events to be analyzed and send them in a single transaction for analysis. This could also be done by configuring the repository as an event reporter and sending them by means of Syslog. This is very inconvenient for both repository and consumer. A simple RESTful PUT of the set of event reports is preferred.</li> </ol>

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Number	Issue
	<p>6. A "bulk push" mode for delivering event reports that have been saved locally for later delivery from an Event Reporter to an Event Record Repository. This may be more efficient or convenient for the Event Reporter, especially for mobile reporters that do not have a native Syslog capability.</p> <p>The alternative is to set up and then take down syslog connections.</p> <p><i><b>It addresses the issue that Apple and Android both have highly performance optimized (battery, storage, etc.) proprietary logging systems. A mobile device can operate offline or with limited connectivity using the proprietary logging system and then offload the accumulated SOLE log to a repository when the device has good power and connectivity.</b></i></p> <p><i><b>We need feedback from ITI as part of PC.</b></i></p>
6	<p>Are the RESTful Syslog query parameters sufficient? Are additional query parameters needed?</p> <p><b>Yes, for TI. Additional query capabilities can be added during TI based on experience and feedback.</b></p> <p>They are very coarse query controls. The primary query is to obtain all syslog reports over a time interval from specific sources. The query is against the Syslog message header parameters, and does not query inside the event message.</p> <p>The role of the server is to maintain the log and provide manageable "chunks" of data to the client. The server does not do detailed filtering. Filters include time range, source, application, message type, and regular expression match of message contents. Final filtering and reporting remain a client task.</p> <p>The bulk of event selection and analysis is performed within the Event Consumer.</p> <p>See Section 4.1.3 for details of basic query capability.</p>
7	<p>Are the right events defined and will the total event flow remain acceptable for traffic limits of syslog? Review list in Section 6.3 and consider what the volume will be like in realistic large environments.</p> <p><b>Feedback: Some events were added and definitions on others revised. No concerns were expressed about traffic levels.</b></p>
8	<p>Should mobile sources be supported in first round using [RAD-124] transaction? Eliminates need to establish solution for the mobile devices that will not support syslog.</p> <p><b>Feedback: YES – If ITI concurs with the approach and is likely to use this for ATNA. Proceed to TI and discuss with ITI.</b></p>
9	<p>Should more detailed events be defined to capture detailed breakdown of patient preparation activities?</p> <p><b>We will not capture patient prep times in detail.</b></p> <p>In general, the time from arrival to procedure room is treated as one activity. Most automatic systems are not able to collect details within this activity. They cannot distinguish between transport time, time in waiting rooms, and clinical preparation time.</p>
10	<p><b><i>Duplicate of 5, merged into 5</i></b></p>
11	<p>A requirement for NTP on mobile devices may be hard to meet. Should this ATNA requirement be relaxed and rephrased?</p> <p><b>Close for RAD, move to ITI. Need to have the same answer for all CT devices.</b></p> <p>For cellular network devices it is nearly impossible to meet. Cellular network devices are usually synchronized with the cellular network time base. The GSM standard timebase is not UTC and does not use NTP. It is a good and sufficient time base, but it is 10 to 20 seconds different than UTC. (GSM does not adjust for leap seconds.) For WiFi-only connected devices NTP may be practical.</p>



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Number	Issue
	The grouping with Time Client is to ensure that all the event reports use the same time base. Is the small consistent offset between UTC and GSM time acceptable? Similar issues arise if the mobile device synchronizes with GPS time. It is also stable and consistent, but 10-20 seconds different than UTC.
12	<p>(To be answered within IHE after discussion). How do we document compliance and grouping? This is similar to the issues with supporting SOPs, specific CDA<sup>®1</sup> formats, etc. The Event Reporter as a generic actor can be documented as complying with the SOLE Profile. That is how this supplement is written.</p> <p>An alternative is to have specific options for various kinds of events.</p> <p><b>Decision: This profile will require product documentation to specify events.</b></p> <p><b>Move this to cross-IHE discussion for what to do about conformance claims?</b></p>
13	<p>Should this profile define events for activities subsequent to completion and delivery of the imaging report?</p> <p><b>No.</b></p> <p>The scope of this profile was limited to this portion of the overall workflow. It is a large enough part of the overall activities to be worth analysis and improvements. Later profiles can be written for other portions of the total healthcare workflow.</p> <p>The total list of events in SWIM does extend further, and it could be enhanced with more events for that purpose.</p>
14	<p>Should SOLE also use the "IHE+RFC3881" identifier or use a distinct identifier "IHE+SOLE"?</p> <p><b>No</b></p> <p>One reason to use IHE+SOLE is to make it easy to do a single query that means "Find all SOLE messages" without parsing the message payloads. The Syslog protocol anticipates that there will be two levels of message identifier that are left to the applications to define. Some commercial Syslog products are configurable to use these levels for filtering and forwarding decisions without needing additional options that parse the contents of the payload.</p> <p>This also proposes an "IHE+SOLE" EventID in the Syslog headers, so that combined events can be reported by multiple EventTypeCodes in the MSG-ID.</p>
15	<p>In the interest of patient privacy we removed the patientID from the SOLE event, and kept the Exam and Accession number. Will this cause problems with any analysis?</p> <p>To trace a particular patient you would need to obtain the patient's exam numbers before patient identity could be derived from the log. How does this affect the ADT phase? Would arrival be logged as "unidentified patient arrived for exams A, B, ... ?</p> <p><b>Feedback: seems OK to do this.</b></p>
16	<b>Merged with 14</b>
17	<p>Should offset and limit support be mandatory?</p> <p><b>Yes – see RFC7233</b></p>
18	<p>Patient Participant includes ParticipantObjectSensitivity for VIPs, etc. Is this level of detail appropriate?</p> <p><b>Feedback – Close, No comments</b></p>

<sup>1</sup> CDA is the registered trademark of Health Level Seven International.

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Number	Issue
19	<p>Location is specified by using two name-value pairs in ParticipantObjectDetail. Should these be coded? Should additional XML structure be defined? Are the variety of location references standardized enough for that level of structure?</p> <p><b>Feedback – Seems acceptable. Let experience in TI determine whether changes are needed.</b></p>
20	<p>Event Cancellation and Exam Exception details are conveyed as additional event codes in the EventTypeCode. Should these be conveyed as a kind of participating object?</p> <p><b>Feedback – NO. The complexity seems unjustified and difficult to implement. Event codes are the right level of detail.</b></p>
21	<p>Should more generic names be used for participants?</p> <p>The event table uses terms from IHE SWF actor names as well as more generic terms like RIS. This may be confusing. For example, the event report for scheduling an appointment identifies the "OrderFiller" machine because SWF specifically identifies that actor as managing appointments. This could lead to confusion with assuming a requirement that all of the IHE requirements for an OrderFiller be met. Should these names be changed to all generic terms?</p> <p><b>Yes, event definitions were changed to generic names.</b></p>
22	<p>How should the list of events that an implementation can detect and report be documented for the purchaser of an implementation?</p> <p><b>Closed – duplicate with earlier event questions</b></p>
23	<p><b>Why are event reports defined in terms of Event, Active Participant, Passive Participant, etc.?</b></p> <p>These terms originate back in the joint DICOM and HL7 group that defined what eventually became RFC3881, later adapted into the DICOM Schema. At the beginning it was thought that this would become part of HL7 v3, not an RFC. It derives from two independent forms of system representations:</p> <ul style="list-style-type: none"> <li>• HL7 v3 had a large complex structure around "acts", and an event is a kind of act.</li> <li>• The Subject Verb Object (SVO) style of system engineering design decomposes all systems into a large collection of sentences (or diagrams) showing each elemental component in the form "Subject(s) Verb Object(s)"</li> </ul> <p>The mapping onto HL7 terminology became "subject" maps to "Active Participant", "verb" maps to event type, and "object" maps to "Passive Participant".</p> <p>Relaxation of rules</p> <p>SVO rules are very strict that there must always be all three. This makes sense as a means of forcing designers to be complete in their understanding of the entire system. It's a major headache if all you want to do is capture partial information for auditing or business analysis purposes. So the RFC, and now DICOM, relaxed this to make only the Event mandatory. The others are usually present, but can be omitted when hard to obtain or irrelevant to the purpose.</p> <p>HL7 v3 had a bunch of extra rules. It was mostly dealing with things like "mood" codes. They were also removed as not needed to audit or track business activities.</p> <p>SVO lacked the "observer" context of HL7 v3 acts, which was captured into the event structure as the audit source. This is the observer of the event itself, not necessarily a participant. It's optional but almost always available.</p> <p>As a result, you can have meaningful partial events such as:</p> <ul style="list-style-type: none"> <li>• "It rained in Boston", where the events are "rain started" and "rain stopped", with a time for each event. There is a passive participant location, "Boston", because saying that the rain started or stopped without saying where is not useful. The design could have augmented the event with a location variable. It did not because</li> </ul>

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Number	Issue
	<p>location is usually not needed, and when it is needed it is often easier to use when treated as a separate searchable participant rather than a detail on event. There is no active participant because the system being studied did not include the details of the atmosphere and its structure.</p> <ul style="list-style-type: none"> <li>• "Application Started", where the event is "application started", with a time for the event. In this case the application itself is called the active participant. This design choice was made because the bulk of the activities performed are within application, and because the kind of descriptive information wanted about the application are a normal part of the active participant description. This is a situation where there are two potential active participants because the hosting system might also be listed as an active participant. If the human user starting the application is needed, it could be the third active participant.</li> </ul>
24	Vol 3 Sec 4.3.2.1 contains IHE-defined codes as placeholders for future RADLEX codes.

145 **History of Changes (as of June 2023)**

Date	Document Revision	Change Summary
June 2023	1.3	Updated by CP-RAD-459. Refer to IHE Radiology's <a href="#">Incorporated CPs</a> .

## IHE Technical Frameworks General Introduction

150 The [IHE Technical Frameworks General Introduction](#) is shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to this document where appropriate.

### 9 Copyright Licenses

155 IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, [Section 9 - Copyright Licenses](#) for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

### 10 Trademark

160 IHE<sup>®</sup> and the IHE logo are trademarks of the Healthcare Information Management Systems Society in the United States and trademarks of IHE Europe in the European Community. Please refer to the IHE Technical Frameworks General Introduction, [Section 10 - Trademark](#) for information on their use.

## IHE Technical Frameworks General Introduction Appendices

165 The [IHE Technical Framework General Introduction Appendices](#) are components shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to these documents where appropriate.

170 *Update the following appendices to the General Introduction as indicated below. Note that these are **not** appendices to this domain’s Technical Framework (TF-1, TF-2, TF-3 or TF-4) but rather, they are appendices to the IHE Technical Frameworks General Introduction located [here](#).*

### [Appendix A – Actors](#)

175 *Add the following **new or modified** actors to the [IHE Technical Frameworks General Introduction Appendix A](#):*

New (or modified) Actor Name	Description
Event Reporter	Composes and sends event reports to other actors.
Event Consumer	Processes event reports.
Event Repository	Receives and manages event reports.

### [Appendix B – Transactions](#)

180 *Add the following **new or modified** transactions to the [IHE Technical Frameworks General Introduction Appendix B](#):*

New (or modified) Transaction Name and Number	Definition
Transfer Multiple Events [RAD-124]	Delivers a payload of many event reports as a single RESTful HTTP POST transaction.

### [Appendix D – Glossary](#)

185 *Add the following **new or modified** glossary terms to the [IHE Technical Frameworks General Introduction Appendix D](#):*

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New (or modified) Glossary Term	Definition	Synonyms	Acronym/ Abbreviation
Event	<p>A real world activity has reached a well-defined state. Events can be organized in a hierarchy and event times can be ambiguous. For example, "Person flew from Boston to Chicago" could be defined as one event. Or, it could also be "Person arrived at parking lot", "person found parking place", "Person arrived at terminal", "person arrived at security line", "person cleared security", ...</p> <p>The level of detail needed is determined by the intended use of the information.</p>		
Event Report	A report describing an Event.		

# Volume 1 – Profiles

*Add Section 43*

## 195 **43 Standardized Operational Log of Events (SOLE) Profile**

The SOLE Profile defines a way to exchange information about business activities that can be collected, analyzed and displayed using standard methods. An example event sequence for a typical patient study might be: "patient arrived", "study started", "study completed", "patient departed", "report completed".

200 Healthcare providers have a strong desire to increase throughput and efficiency, both to improve the quality and timeliness of care and to control costs. These process improvement efforts depend on being able to capture workflow events and apply business intelligence tools. This profile provides:

- 205 • Event descriptions for the commonly reported events based on the SWIM initiative experience. Unique local events can be added.
- A standard method to collect the event reports as they are logged from many different systems. This accommodates both real time collection from networked devices, and delayed collection from mobile devices.
- 210 • The ability to analyze data provided by many different vendors without writing special software for each vendor.
- The ability to compare experiences between different organizations.

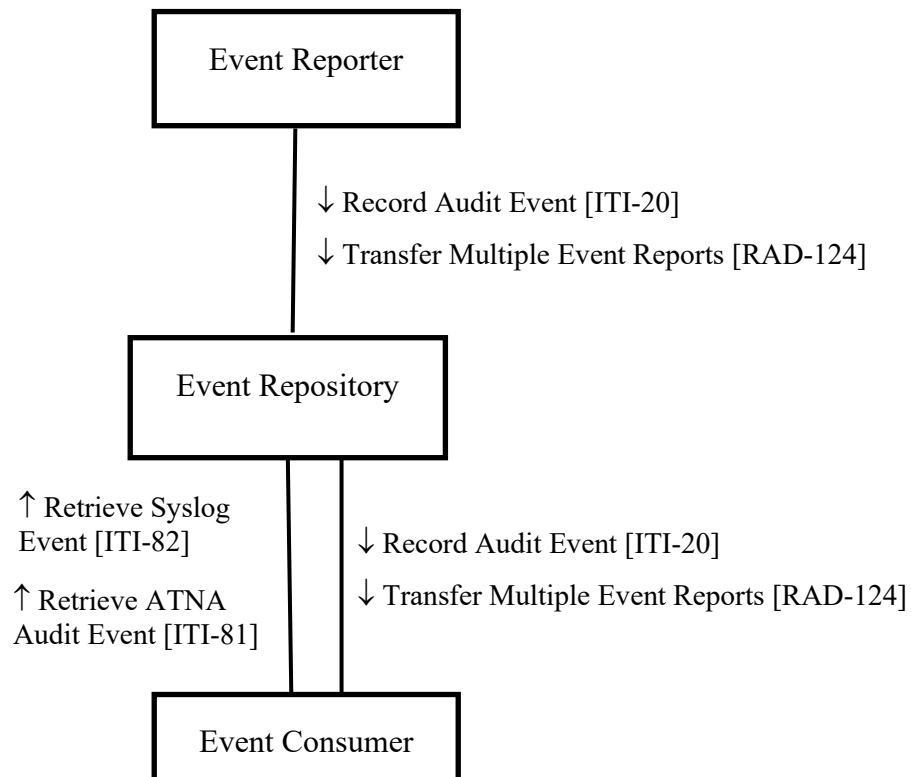
### **43.1 SOLE Actors, Transactions, and Content Modules**

This section defines the actors, transactions, and/or content modules in this profile. General definitions of actors are given in the Technical Frameworks General Introduction Appendix A at 215 [http://ihe.net/Technical\\_Frameworks](http://ihe.net/Technical_Frameworks).

Figure 43.1-1 shows the actors directly involved in the SOLE Profile and the relevant transactions between them. If needed for context, other actors that may be indirectly involved due to their participation in other related profiles are shown in dotted lines. Actors which have a mandatory grouping are shown in conjoined boxes.

220





**Figure 43.1-1: SOLE Actor Diagram**

225 Table 43.1-1 lists the transactions for each actor directly involved in the SOLE Profile. To claim compliance with this profile, an actor shall support all required transactions (labeled "R") and may support the optional transactions (labeled "O").

**Table 43.1-1: SOLE Profile - Actors and Transactions**

Actors	Transactions	Initiator or Responder	Optionality	TF Reference
Event Reporter	Record Audit Event [ITI-20]	Initiator	R	<a href="#">ITI TF-2: 3.20</a>
	Transfer Multiple Events [RAD-124]	Initiator	O	RAD TF-2: 4.124
Event Repository	Record Audit Event [ITI-20] (Note 1)	Responder	R	<a href="#">ITI TF-2: 3.20</a>
	Transfer Multiple Events [RAD-124] (Note 1)	Initiator or Responder	R	RAD TF-2: 4.124
	Retrieve Syslog Event [ITI-82]	Responder	R	<a href="#">ITI TF-2: 3.82</a>
	Retrieve ATNA Audit Event [ITI-81]	Responder	R	<a href="#">ITI TF-2: 3.81</a>

Actors	Transactions	Initiator or Responder	Optionality	TF Reference
Event Consumer	Record Audit Event [ITI-20]	Responder	O	<a href="#">ITI TF-2: 3.20</a>
	Transfer Multiple Events [RAD-124]	Responder	O	RAD TF-2: 4.124
	Retrieve Syslog Event [ITI-82]	Initiator	R	<a href="#">ITI TF-2: 3.82</a>
	Retrieve ATNA Audit Event [ITI-81]	Initiator	O	<a href="#">ITI TF-2: 3.81</a>

Note 1: The Event Repository is required to implement [RAD-124] as both the Sender and the Receiver. The Event Repository is required to implement [ITI-20] as both an Audit Record Creator and an Audit Record Repository.

230

**Table 43.1-2: SOLE Profile - Actors and Content Modules**

Actors	Content Modules	Optionality	TF Reference
Event Reporter	SOLE Event	R	RAD TF-3: 6.3 SOLE Event Definitions
Event Repository	SOLE Event	R	RAD TF-3: 6.3 SOLE Event Definitions
Event Consumer	SOLE Event	R	RAD TF-3: 6.3 SOLE Event Definitions

### 43.1.1 Actor Descriptions and Actor Profile Requirements

Most requirements are documented in Transactions (Volume 2) and Content Modules (Volume 3). This section documents any additional requirements on profile’s actors.

235

#### 43.1.1.1 Event Reporter

The Event Reporter shall report events in RAD TF-3: Table 6.3.2-1 Baseline SOLE Events when they occur on the Event Reporter and grouped actors. The Event Reporter shall document which events it can detect and report.

240

The Event Reporter shall report SOLE events using Syslog messages that comply with the SOLE Event Content Module definition.

The Event Reporter shall be configurable as to the events to be reported, and the Event Repositories to which they are to be reported.

The Event Reporter shall detect when network connectivity is not available. When network connectivity is not available, event reports shall still be stored locally for later delivery.

245

The Event Reporter shall be able to manually or automatically transfer the locally stored event reports to an Event Repository when network connectivity is made available.

### 43.1.1.2 Event Repository

250 The Event Repository shall be able to store all event reports in RAD TF-3: Table 6.3.2-1 Baseline SOLE Events. The Event Repository is permitted to remove locally stored event reports based on business logic.

The Event Repository shall be configurable to support filtering and forwarding event reports to other Event Repositories or Event Consumers. See Section 43.4.1.3.

The Event Repository shall not generate an error when it receives a Syslog RFC-compliant event report with a malformed SOLE payload.

### 255 43.1.1.3 Event Consumer

The Event Consumer shall be able to receive any SOLE event report in RAD TF-3: Table 6.3.2-1 Baseline SOLE Events. The Event Consumer is not required to process all types of event reports.

260 The Event Consumer processes event reports for analysis or display. This profile does not specify the nature of the analysis or display to be performed. An Event Consumer may be a business process analysis system that is being used to improve a clinical workflow. An Event Consumer may be a "dashboard" system that continuously displays the present state of work activities at a location.

## 43.2 SOLE Actor Options

265 Options that may be selected for each actor in this profile, if any, are listed in Table 43.2-1. Dependencies between options when applicable are specified in notes.

**Table 43.2-1: Standardized Operational Log of Events - Actors and Options**

Actor	Option Name	TF Reference
Event Reporter	Multiple Events Option	Section 43.2.1
Event Consumer	Multiple Events Option	Section 43.2.1
	Retrieve Audit Message Option	Section 43.2.2
Event Repository	No options defined	--

### 43.2.1 Multiple Event Option

270 An Event Reporter that supports the Multiple Events Option shall be able to send event reports by means of the Transfer Multiple Events [RAD-124] transaction. This option does not specify the user interface or system logic used to determine what event reports are to be sent or how the destination is selected or configured.

An Event Consumer that supports the Multiple Events Option shall be able to accept event reports sent by means of the Transfer Multiple Events [RAD-124] transaction. This actor shall be able to process or store these event reports in the same way as event reports sent by other means.

275 Support for multiple events is already mandatory for the Event Repository.

### 43.2.2 Retrieve Audit Message Option

An Event Consumer that supports the Retrieve Audit Message Option shall be able to use the Retrieve ATNA Audit Event [ITI-81] transaction to obtain event reports. This provides another RESTful search using FHIR<sup>®2</sup> resources.

280 Support for Retrieve ATNA Audit Event [ITI-81] is already mandatory for the Event Repository.

### 43.3 SOLE Required Actor Groupings

An actor from this profile (Column 1) shall implement all of the required transactions and/or content modules in this profile *in addition to* all of the transactions required for the grouped actor (Column 2).

285 It is important that the time base for all actors that record or display time be the same. The Event Reporter shall be grouped with the Time Client for this reason.

**Table 43.3-1: Standardized Operational Log of Events - Required Actor Groupings**

SOLE Actor	Actor to be grouped with	Reference	Content Bindings Reference
Event Reporter	Consistent Time / Time Client	<a href="#">ITI TF-1: 7.1</a>	--
Event Repository	None	--	--
Event Consumer	None	--	--

### 43.4 SOLE Overview

#### 43.4.1 Concepts

290 The SIIM Workflow Initiative in Medicine (SWIM<sup>™</sup>) is a Society for Imaging Informatics in Medicine sponsored initiative with initial goals of developing:

- a. Common definition of the workflow steps within medical imaging departments
- b. Key performance indicators that are defined using these workflow steps
- c. Definitions of the data elements used to capture information about the workflow steps associated with these key performance indicators

295

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<sup>2</sup> FHIR is the registered trademark of Health Level Seven International.

#### 43.4.1.1 Events and extending events

The SOLE Profile has defined a baseline of events of interest that take place during the imaging process at imaging departments.

300 The baseline SOLE events in RAD TF-3: Table 6.3.2-1 Baseline SOLE Events shall be used when applicable by all actors in the SOLE Profile.

A deployment may extend the list of events reported for local purposes by extending the baseline SOLE events with reports for other events in the SWIM list at

<http://siim.org/resource/resmgr/swim/SWIMRadlex1.xlsx>.

305 New events that are not defined by SWIM are best handled by coordinating with SIIM to get those events incorporated into the SWIM definition.

Event reports can also be extended with new data elements. These local extensions should not conflict with the existing data elements in the event report, and may be ignored by the Event Consumer.

310 An Event Repository may store any event report and shall not modify the contents of the event report.

An Event Consumer that receives event reports with extensions will not generate errors, but these event reports are less likely to be understood.

#### 43.4.1.2 Derived Events

315 The occurrence of an event could be deduced by an actor other than the one where the event occurred. For example, the acquisition start and completion could be deduced by a RIS, based on the MPPS contents and the Series contents of the associated DICOM<sup>®3</sup> images. This may be used to accommodate the transition from old systems that do not detect and report events to new systems that do.

320 Note: The DICOM Event Schema will be modified by a DICOM CP that adds a "derived" element with optional derivation description elements to accommodate these situations. Some of the events that are hard to detect directly with current equipment may be reported based on derivation from other available data.

#### 43.4.1.3 Retrieving Event Reports

The Event Consumer can retrieve data for analysis by using either of the two event report retrieval transactions defined in the ITI Technical Framework.

325 The Retrieve Syslog Message [ITI-82] retrieves Event Reports formatted as syslog messages including those unrelated to SOLE, e.g., IHE ITI ATNA audit events.

---

<sup>3</sup> DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

The [ITI-82] transaction supports searches against mandatory Syslog header fields; see Table 43.3.1.3-1. A very common query is to specify a time range and APP-NAME to get all events for an application, e.g., SOLE, for a given time period.

330

**Table 43.4.1.3-1: Retrieve Syslog Message Keys**

Syslog RFC5424 element	Retrieve Syslog Message Search Parameter
PRI	The value for all SOLE messages will likely be 136. "13" means a syslog category of "audit system", and "6" means a severity of "informational". The final digit (severity) may change, e.g., "131" for alert conditions. Other values can be found in other syslog messages.
TIMESTAMP	Time of message (date range query is supported)
HOSTNAME	Name of machine that originated the syslog message
APP-NAME	Filter results to those associated with a particular application code identifying the kind of message. E.g., the APP-NAME "IHE+SOLE" limits results to SOLE event reports. Note: This is unrelated to application descriptions or other information carried in the body of the messages.
PROCID	Typically a process ID for a syslog process. Used to identify logging discontinuities.
MSG-ID	SOLE has specified that this will be the SOLE EventTypeCodes, e.g., "RID4585".
MSG	Regular expression for the Event Repository to match against the Message body.

The Retrieve ATNA Audit Event [ITI-81] transaction retrieves Event Reports formatted as HL7 FHIR AuditEvent Resources.

The [ITI-81] transaction supports searches based on AuditEvent Resource attributes:

335

- **Patient identifier:** for event reports related to a specific patient;
- **User identifier:** for actions performed by a specific user
- **Object identifier:** for event reports related to a specific object (like study, reports, image, etc.).
- **Time frame:** for event reports that occurred during a specific time frame.

340

- **Event type:** for occurrences of a specific event type (like Data Export, Data Import, Query, Authentication, etc.).
- **Application identifier:** for event reports recorded by a specific application or system.
- **Event Outcome Indicator:** for event reports characterized by a specific outcome (Success, Failure, etc.).

345

#### 43.4.1.4 Filter and Forward

350 Event Repositories can provide filtering and forwarding of event reports to other Event Repositories and to Event Consumers for any purpose; it is not just for dashboards. The Event Repository is configured with information about the Event Consumers that should receive a selection of event reports. This selection and filtering capability sometimes involves examination of the detailed contents of the event reports.

355 Filtering and forwarding has been used to create federated reporting systems, and to allow sharing of one Event Repository for multiple independent event reporting streams. An Event Repository may be gathering security and privacy event reports in accordance with the IHE ITI [Audit Trail and Node Authentication](#) (ATNA) Profile, proprietary database events, facility maintenance events, etc. All of these can use syslog and the same Event Repository.

Syslog event streams, such as selected ATNA and SOLE event reports, might be combined and sent to an integrated activity dashboard, while a separate complete ATNA event report stream is also sent to the security office for use by the security system dashboard.

360 This profile requires that there be filtering and forwarding capabilities. This profile does not specify feature requirements for the filtering capabilities of an Event Repository. The specific filtering features are part of the product feature set determined by a vendor. This forwarding may be performed using a bulk transfer if both ends support the bulk transfer. Forwarding with [ITI-20] is always supported between Event Repositories.

#### 365 43.4.2 Use Cases

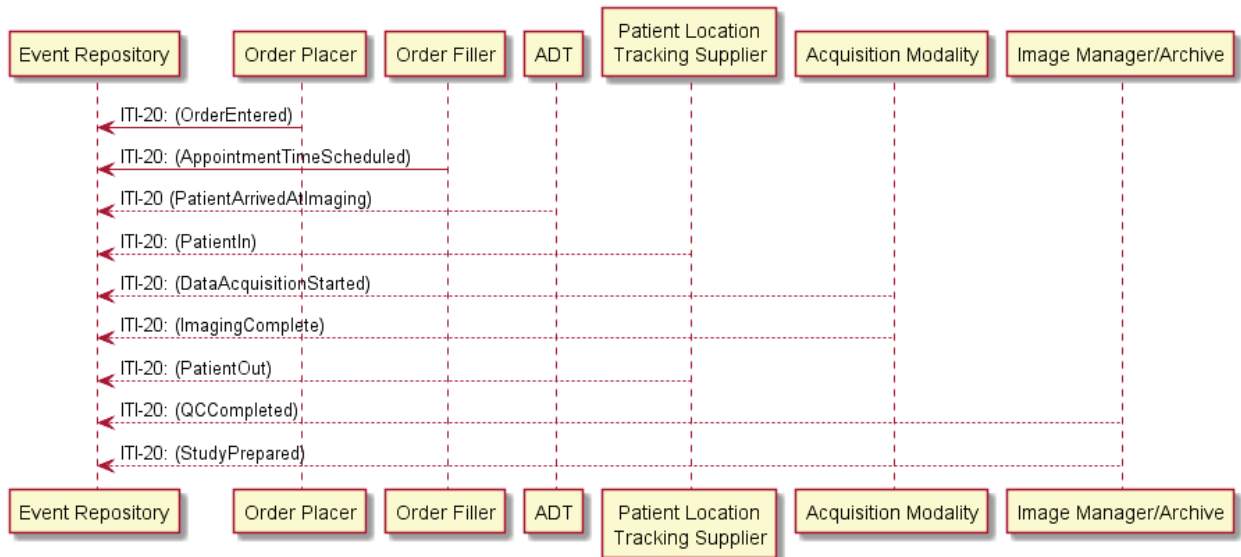
The use cases 1, 2, and 4 are derived from the SWIM initiative use cases.

##### 43.4.2.1 Use Case #1: Track Study Reading Activities

370 The following scenario shows a selection of events from a routine radiology reading activity that follows the Radiology Scheduled Workflow Profile and reports events defined by SOLE. The diagram shows each actor that is grouped with the Event Reporter but does not show the Event Reporter itself. The diagrams are split between acquisition and preparation in the first diagram, and reporting in the second diagram.

375 As each event takes place, the actors that are grouped with an Event Reporter that complies with the SOLE Profile will use the [ITI-20] transaction to convey the event description to the Event Repository.

The Event Repository archives these event reports for a configurable period of time so that subsequent analysis can be performed.



380 **Figure 43.4.2.1-1: Event reporting during image acquisition phase**

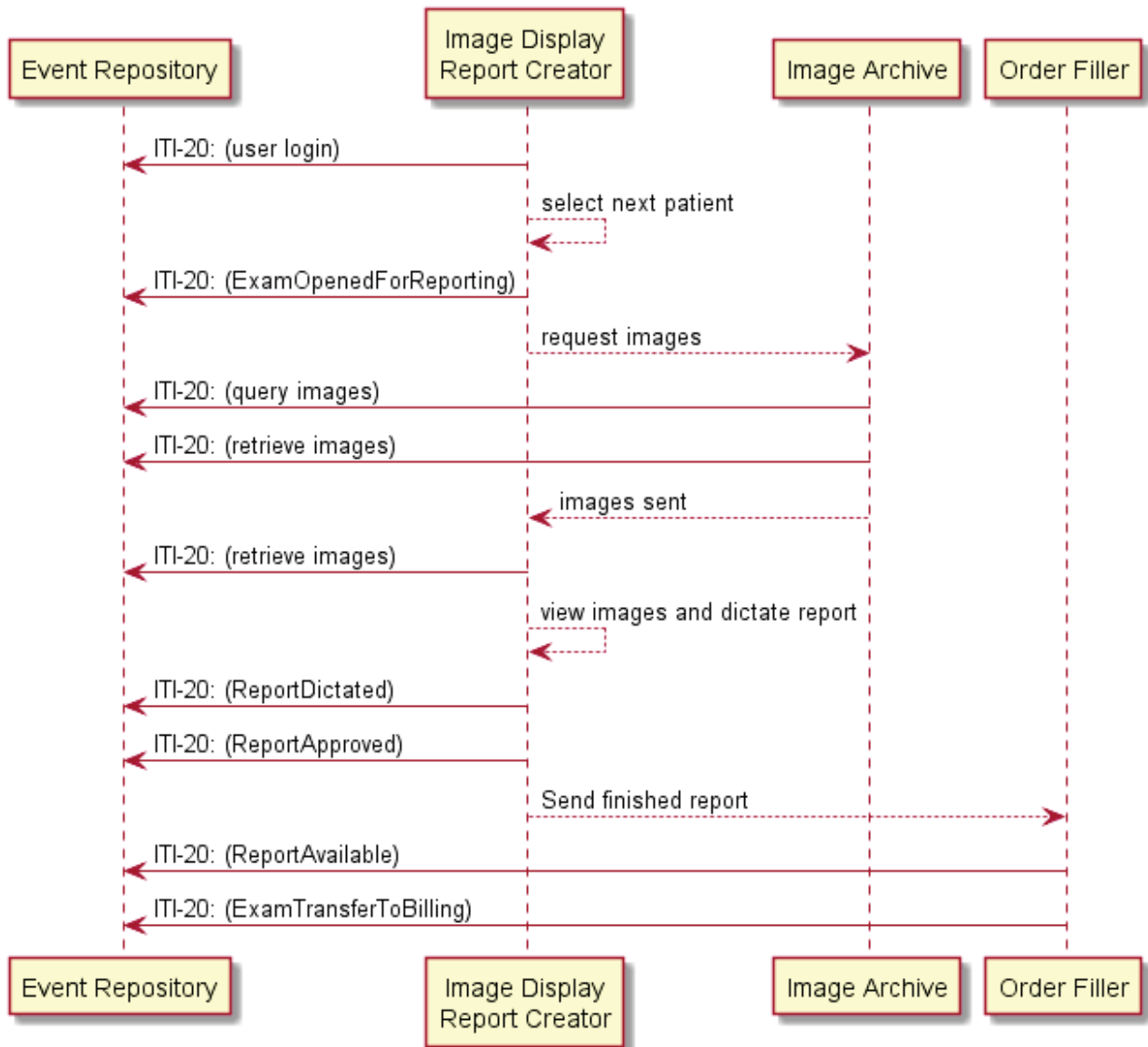
The text in Figure 43.4.2.1-2 was used to generate the diagram in Figure 43.4.2.1-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```

385 Order-perform-study.txt
@startuml
participant "Event Repository"
390 "Order Placer" -> "Event Repository" : ITI-20: (Order Entered)
"Order Filler" -> "Event Repository" : ITI-20: (AppointmentTimeScheduled)
"ADT" --> "Event Repository" : ITI-20 (PatientArrivedAtImaging)
"Patient Location\nTracking Supplier" --> "Event Repository" : ITI-20: (PatientIn)
395 "Acquisition Modality" --> "Event Repository" : ITI-20: (DataAcquisitionStarted)
"Acquisition Modality" --> "Event Repository" : ITI-20: (ImagingComplete)
"Patient Location\nTracking Supplier" --> "Event Repository" : ITI-20: (PatientOut)
"Image Manager/Archive" --> "Event Repository" : ITI-20: (QCCompleted)
400 "Image Manager/Archive" --> "Event Repository" : ITI-20: (StudyPrepared)
@enduml
    
```

**Figure 43.4.2.1-2: Pseudocode for Event reporting during image acquisition phase**





405

**Figure 43.4.2.1-3: Event reporting during study reporting phase**

The text in Figure 43.4.2.1-4 was used to generate the diagram in Figure 43.4.2.1-3. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
410 Routine-report.txt
@startuml
participant "Event Repository"
participant "Image Display\nReport Creator" as Display
415 Display -> "Event Repository" : ITI-20: (user login)
Display --> Display : select next patient
Display -> "Event Repository" : ITI-20: (ExamOpenedForReporting)
Display --> "Image Archive" : request images
420 "Image Archive" -> "Event Repository" : ITI-20: (query images)
"Image Archive" -> "Event Repository" : ITI-20: (retrieve images-archive)
"Image Archive" --> Display : images sent
Display -> "Event Repository" : ITI-20: (retrieve images-display)
Display --> Display : view images and dictate report
425 Display -> "Event Repository" : ITI-20: (ReportDictated)
Display -> "Event Repository" : ITI-20: (ReportApproved)
Display --> "Order Filler" : Send finished report
"Order Filler" -> "Event Repository" : ITI-20: (ReportAvailable)
"Order Filler" -> "Event Repository" : ITI-20: (ExamTransferToBilling)
430 @enduml
```

**Figure 43.4.2.1-4: Pseudocode for Event reporting during study reporting phase**

### 43.4.2.2 Use Case #2: Analyze Events

435 An analyst can use SOLE event reports to study the workflow and operations of a facility. The events have already taken place and are archived in the repository. The analyst selects the appropriate time span to be studied and determines the event reporters that may be reporting relevant information. An analysis workstation acts as an Event Consumer and requests all the data from those data sources during that time period. This will include the SOLE event reports and may include a variety of other event reports.

440 The analyst might use data import tools to ingest the event reports into an appropriate database or analysis system. For example, this might be a free text indexing database, or it could be an object database designed to hold SOLE event reports.

The analyst uses this information to generate the analyses and reports of the workflow based on the event reports and other information.

445

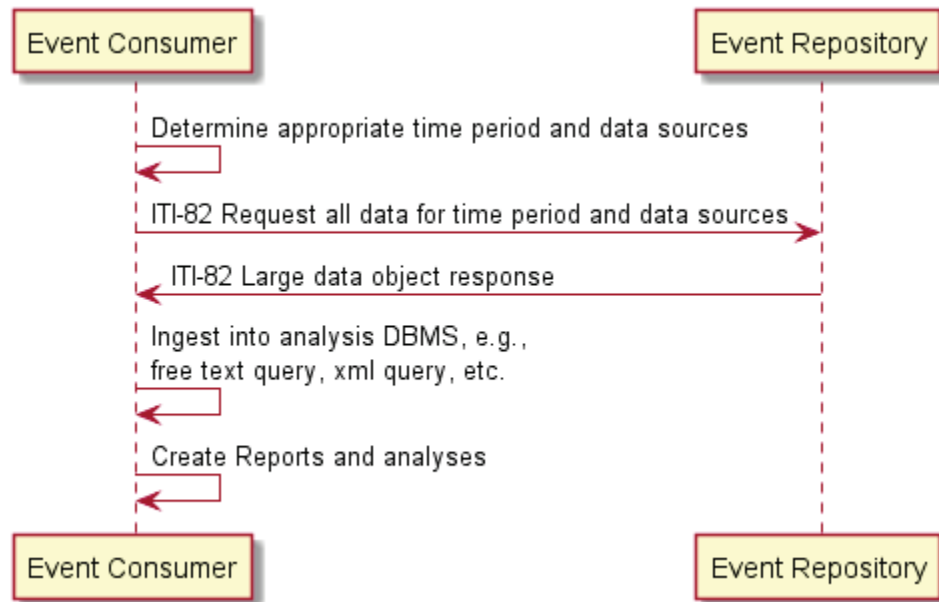


Figure 43.4.2.2-1: Imaging center activity analysis workflow

The text in Figure 43.4.2.2-2 was used to generate the diagram in Figure 43.4.2.2-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

450

```
Syslog-query.txt
@startuml

"Event Consumer" -> "Event Consumer" : Determine appropriate time period and data sources
"Event Consumer" -> "Event Repository" : ITI-82 (Request all data for time period and data sources)
"Event Repository" -> "Event Consumer" : ITI-82 (Large data object response)
"Event Consumer" -> "Event Consumer" : Ingest into analysis DBMS, e.g., free text query, xml query, etc.
"Event Consumer" -> "Event Consumer" : Create Reports and analyses

@enduml
```

455

460

Figure 43.4.2.2-2: Pseudocode for Imaging center activity analysis workflow

### 465 43.4.2.3 Use Case #3: Delayed Event Delivery (mobile)

A mobile device that includes an Event Reporter can operate without a network connection to the Event Repository.

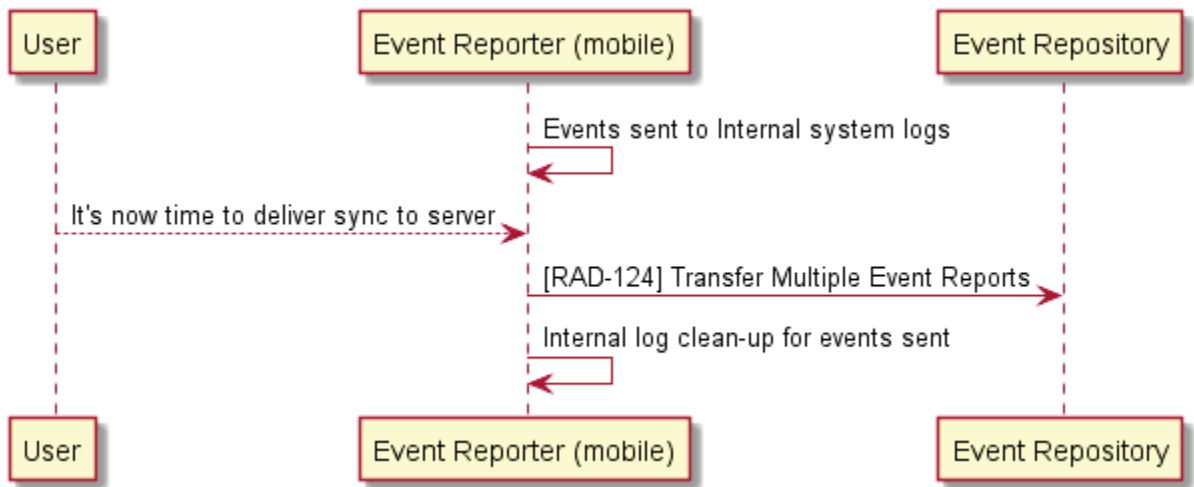
Mobile platforms have connectivity, battery, and storage considerations that have driven the development of solutions that are customized to the device's hardware and capabilities. For example, Android and iOS both have proprietary logging systems that operate locally and require applications to fetch the local logs for transmission by some other means.

470

475 While operating without a connection, the mobile device accumulates internally formatted event reports for those SOLE events that take place. This internal format uses the proprietary internal logging format provided by the mobile device OS, so that battery use and storage use can be optimized as designed by the device OS vendor.

When the mobile device is returned to "home base", where it has a reliable network connection, the mobile device operator instructs it to perform the "end of shift" operations. These operations include the retrieval of the SOLE event reports from the internal log storage, reformatting into the SOLE event report format, and transfer from the mobile device to the event repository.

480 After successfully transferring the event reports to the Event Repository the mobile device cleans its internal log storage in preparation for future mobile activity.



**Figure 43.4.2.3-1: Event report transfer from mobile device**

485 The text in Figure 43.4.2.3-2 was used to generate the diagram in Figure 43.4.2.3-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```

490 Mobile-push.txt
@startuml
participant User

"Event Reporter (mobile)" -> "Event Reporter (mobile)" : Events sent to Internal system logs
"User" --> "Event Reporter (mobile)" : It's now time to deliver sync to server
"Event Reporter (mobile)" -> "Event Repository" : [RAD-124] Transfer Multiple Events
"Event Reporter (mobile)" -> "Event Reporter (mobile)" : Internal log clean-up for events sent

@enduml

```

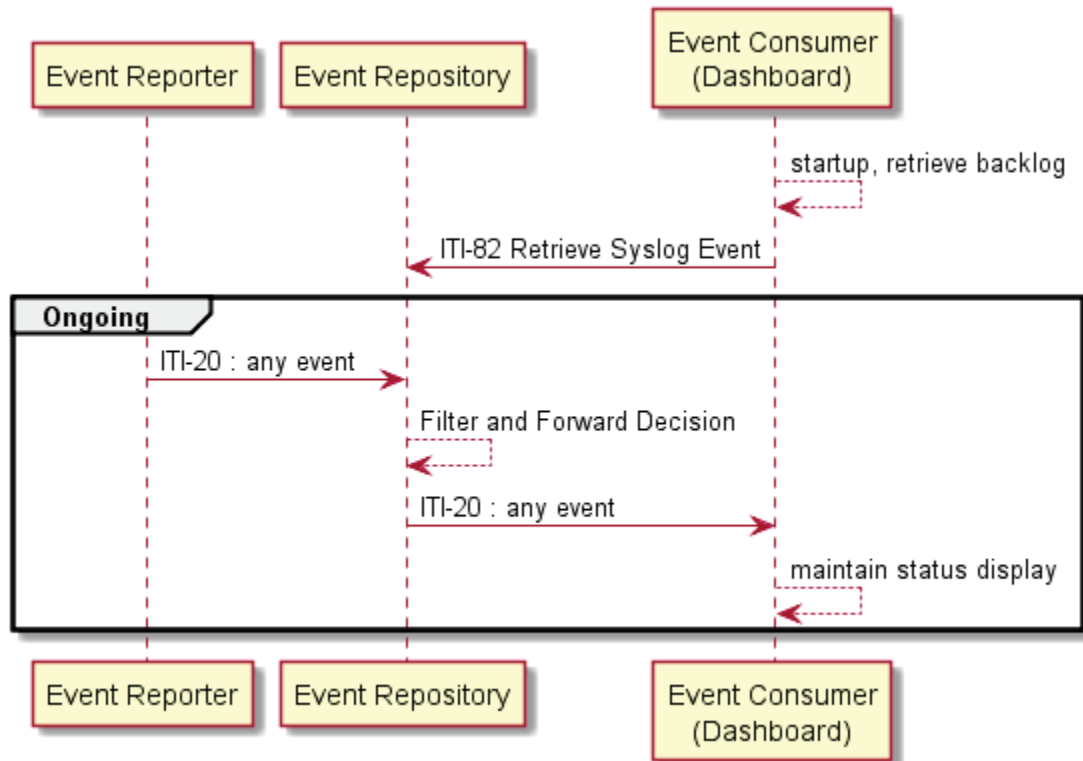
500 **Figure 43.4.2.3-2: Pseudocode for Event reporting during image acquisition phase**

#### 43.4.2.4 Use Case #4: Dashboard

505 A clinic maintains operational awareness for their staff by maintaining a "dashboard" that displays the current status of equipment, waiting room queues, processing queues, reporting queues, etc. This display is regularly updated to reflect the current situation as patients arrive, are imaged, and depart.

This dashboard receives SOLE event reports from the Event Repository as they are received by the Event Repository. The Event Repository is configured to filter the event reports that it receives to eliminate reports that should not be displayed, e.g., user login reports and security audit reports, and to eliminate SOLE reports from sources that should not be displayed.

510 The dashboard system uses the SOLE event reports to maintain and update the internal status description used generate the graphics of the dashboard.



**Figure 43.4.2.4-1: Dashboard Event Flow**

515 The text in Figure 43.4.2.4-2 was used to generate the diagram in Figure 43.4.2.4-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
pix-rest-workflow.txt
@startuml
520 participant "Event Reporter"
   participant "Event Repository"
   participant dashboard as "Event Consumer\n(Dashboard) "
525 dashboard --> dashboard : startup, retrieve backlog
   dashboard -> "Event Repository" : ITI-82 Retrieve Syslog Event
   group Ongoing
   "Event Reporter" -> "Event Repository" : ITI-20 : any event
530 "Event Repository" --> "Event Repository" : Filter and Forward Decision
   "Event Repository" -> dashboard : ITI-20 PUT NAME HERE
   dashboard --> dashboard : maintain status display
   end
535 @enduml
```

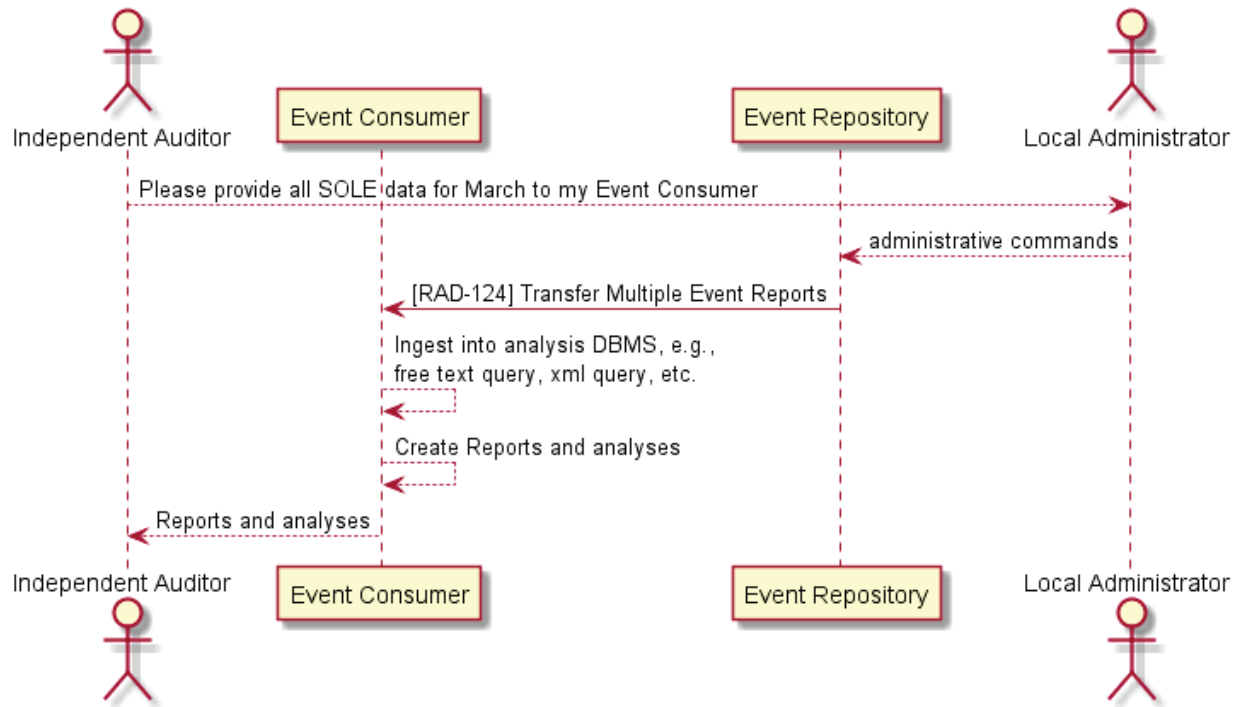
**Figure 43.4.2.4-2: Pseudocode for Dashboard Event Flow**

#### 43.4.2.5 Use Case #5: RESTful Delivery

540 An outside independent auditor requests the SOLE data be provided for a specific time period, e.g., "March". This is an authorized and approved release of data, but the auditor's access to the network and facility must be limited. Local policy is that rather than provide the auditors direct access to the facility, a data extract will be provided to the auditor.

545 The Event Repository has an administrative function that allows it to perform a RESTful HTTP POST of the SOLE event reports from a specified time period. The operators of the Event Repository use the Transfer Multiple Events [RAD-124] transaction to send the requested data to the auditor's Event Consumer.

Subsequent data ingest, analysis, and reporting are performed by the independent auditor on the auditor's system.



550

**Figure 43.4.2.5-1: Delivery of data for external analysis**

The text in Figure 43.4.2.5-2 was used to generate the diagram in Figure 43.4.2.5-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

555

```

Analysis-push.txt
@startuml
actor "Independent Auditor"
participant "Event Consumer"
participant "Event Repository"
actor "Local Administrator"

"Independent Auditor" --> "Local Administrator" : Please provide all SOLE data for March to my
Event Consumer
"Local Administrator" --> "Event Repository" : administrative commands
"Event Repository" -> "Event Consumer" : [RAD-124] Transfer Multiple Events
"Event Consumer" --> "Event Consumer" : Ingest into analysis DBMS, e.g.,\nfree text query, xml
query, etc.
"Event Consumer" --> "Event Consumer" : Create Reports and analyses
"Event Consumer" --> "Independent Auditor" : Reports and analyses

@enduml
    
```

570

575

**Figure 43.4.2.5-2: Pseudocode for Delivery of data for external analysis**

## 43.5 SOLE Security Considerations

### 43.5.1 Security Considerations for Actors

The Event Reporter will need the same protections as the actors that it monitors and reports on.

580 The Event Repository does contain a modest amount of PHI and private information about employees and staff. This information is subject to data protection regulations in most countries. The specific protections needed depend upon the jurisdiction and extent of system monitoring.

The Event Consumer may contain PHI and private information about employees and staff. This information is subject to data protection regulations in most countries. The specific protections needed depend upon the jurisdiction and extent of system monitoring.

### 585 43.5.2 Security Considerations for Event Reports

590 The event reports have been designed to exclude most patient information. The progression of the patient through the system is documented in terms of the Study Instance UID or accession number as the identifier for an imaging study, not the patient identification. The accession number in combination with other information may be able to reveal the patient identity, but it is much more work and easier to detect penetration attempts. The local risk analysis and jurisdiction will determine the protections needed for this information. Study identification is sometimes considered sufficient de-identification, and sometimes it is not.

The patient ID is captured for admissions and discharges, and it can be associated with studies for that patient. A deployment might choose not to capture these events.

595 The workflow analysis of a facility does not usually need to know the identities of the patients. The analyses can be equally effective using Study Instance UID instead of patient number. If needed, the patient ID could be obtained using the Study Instance UID and EMR records.

600 The personal work-related information about staff, such as when they participated in a particular study or procedure, is captured in the events. There may be jurisdictions that restrict this kind of worker monitoring, or that place additional confidentiality requirements on its storage.

## 43.6 SOLE Cross Profile Considerations

605 The Record Audit Event [ITI-20] transaction may be extended by other profiles. This may result in a mixing of SOLE event reports with other types of event reports. The Event Repository will need to be prepared for this. The Event Consumer may find event reports defined in other profiles that happen to match a query and that get returned with the other matching reports.

An ATNA Audit Record Repository is required to accept all event reports, but if it does not support the SOLE Profile it may discard the SOLE Events. If it supports both ATNA and SOLE Profiles, it will maintain all these event reports. Similarly, a SOLE Event Repository is required to accept ATNA event reports, but if it does not claim the ATNA Profile it may discard them.



610 ATNA events are the security surveillance events, whereas SOLE events are workflow status and analysis related events.

Any actor in Scheduled Workflow.b might be grouped with the Event Reporter to perform logging of events for workflow analysis.

Event Consumer and Event Repository in SOLE should be grouped with the CT Time Client.

615

## Volume 2 – Transactions

*Add Section 4.124*

### 4.124 Transfer Multiple Events [RAD-124]

#### 4.124.1 Scope

620 This transaction transfers in bulk event records, audit records, and other records in syslog format.

Note: This transaction could be used as an alternative to Record Audit Event [ITI-20] by performing a [RAD-124] transaction for each syslog message. This is not advisable because of the much higher performance impact.

#### 4.124.2 Actor Roles

625 The roles in this transaction are defined in the following table and may be played by the actors shown here:

**Table 4.124.2-1: Actor Roles**

<b>Role:</b>	Sender: Sends many event records
<b>Actor(s):</b>	The following actors may play the role of Sender: Event Reporter Event Repository
<b>Role:</b>	Receiver: Receives and processes many event records
<b>Actor(s):</b>	The following actors may play the role of Receiver: Event Repository Event Consumer

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

#### 630 4.124.3 Referenced Standards

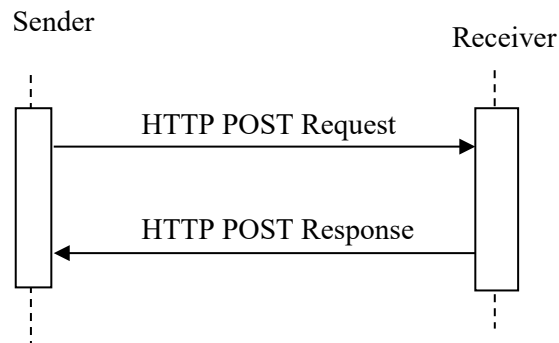
[RFC1945] IETF. May 1996. Hypertext Transfer Protocol Version 1.0 (HTTP/1.0). <http://tools.ietf.org/html/rfc1945>.

[RFC2818] IETF. May 2000. HTTP Over TLS. <http://tools.ietf.org/html/rfc2818>.

635 [RFC5234] IETF. January 2008. Augmented BNF for Syntax Specifications: ABNF.  
<http://tools.ietf.org/html/rfc5234>

[RFC7230] IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing. <http://tools.ietf.org/html/rfc7230>.

#### 4.124.4 Messages



640 **Figure 4.124.4-1: Interaction Diagram**

##### 4.124.4.1 HTTP POST Request

The Sender sends a collection of syslog messages to the Receiver.

The Receiver shall support handling such messages from more than one Sender. The Sender shall support making requests to more than one Receiver.

##### 645 4.124.4.1.1 Trigger Events

The Sender determines that it has a sufficient collection of syslog reports. For example, a mobile device could initiate this transaction when it returns to a home location.

##### 4.124.4.1.2 Message Semantics

650 The message is an HTTP POST request. The Sender is the user-agent. The Receiver is the origin-server. The request syntax in ABNF (see RFC5234) is:

```
POST SP /{bulk-syslog-events} SP version CRLF
Content-Type: dicom-media-type CRLF
*(header-field CRLF)
CRLF
payload
```

#### 4.124.4.1.2.1 Resource

The target URL shall be `<scheme>://<authority>/<path>/bulk-syslog-events`.

#### 660 4.124.4.1.2.2 Query Parameters

There are no Query Parameters.

#### 4.124.4.1.2.3 Request Header Fields

**Table 4.124.4.1.2.3-1: Request Header Fields**

Header Field	Data Type	Usage	Description
Accept	media-type	M	Shall contain "application/json"
Accept-Charset	charset	O	List of one or more character sets
Content-Type	media-type	M	Shall contain "application/json"
Content-Length	int	C	Required if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	C	Required if a transfer coding has been applied. Shall be absent otherwise.

#### 4.124.4.1.2.4 Request Payload

665 The request payload shall be present and shall contain one or more JSON encoded bulk event records.

The syslog messages shall be encoded as described in ITI TF-2: Table 3.82.4.2.2-1. See the ITI [Add RESTful ATNA \(Query and Feed\)](#) Trial Implementation supplement.

#### 4.124.4.1.2.4.1 Example JSON encoding

670

675

680

685

```
{ "Events": [  
  {  
    "Pri" : "103",  
    "Version": "1",  
    "Timestamp": "2015-03-17T00:05"  
    "Hostname": "nemo.frodo.org"  
    "App-name": "su"  
    "Procid": "1234"  
    "Msg-id": "su-fail"  
    "Msg": "su root failed for sauron"  
  },  
  {  
    "Pri": "101",  
    "Version": "1",  
    "Timestamp": "2015-03-17T00:06"
```

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```

690     "Hostname": "nemo.frodo.org"
        "App-name": "su"
        "Procid": "1234"
        "Msg-id": "su-start"
        "Msg": "su root succeeded for gandalf"
        },
        {
695     "Pri": "101",
        "Version": "1",
        "Timestamp": "2015-03-17T00:15"
        "Hostname": "nemo.frodo.org"
        "App-name": "su"
        "Procid": "1234"
        "Msg-id": "su-stop"
700     "Msg": "su root completed for gandalf"
        },
    {
705     "Pri": "136",
        "version": "1",
        "Timestamp": "2015-03-17T00:15"
        "Hostname": "nemo.frodo.org"
        "App-name": "IHE+SOLE"
        "Procid": "1234"
        "Msg-id": "RID45813"
710     "Msg": "<?xml version="1.0" encoding="UTF-8"?> <AuditMessage>
        <EventIdentification EventDateTime="2016-10-17T15:12:04.287-06:00"
        EventOutcomeIndicator="0"
        EventActionCode="E">
715     <EventID csd-code="SOLE67" codeSystemName="urn:ihe:rad" originalText="Imaging
        Operational Event" />
        <EventTypeCode csd-code="RID45813" codeSystemName="RadLex" originalText="Order Entered" />
        </EventIdentification>
        <ActiveParticipant UserID="EmpID12345678"
720     UserIsRequestor="true">
        <RoleIDCode csd-code="121096" codeSystemName="DCM" originalText="Ordering Physician" />
        <Shift 3 />
        <Department Emergency />
        </ActiveParticipant>
725     <ActiveParticipant UserID="EMR7"
        UserIsRequestor="false"
        NetworkAccessPointTypeCode="1"
        NetworkAccessPointID="125.20.175.12">
        <RoleIDCode csd-code="110150" codeSystemName="DCM" originalText="Application" />
730     <RoleIDCode csd-code="SOLE59" codeSystemName="urn:ihe:rad" originalText="Automated Order
        Machine" />
        </ActiveParticipant>
        <AuditSourceIdentification code="1"
735     AuditEnterpriseSiteID="End User" AuditSourceID="farley.granger@wb.com"/>
        <ParticipantObjectIdentification
        ParticipantObjectTypeCodeRole="4" ParticipantObjectID="12345678654321">
        <ParticipantObjectIDTypeCode csd-code="363679005" codeSystemName="SNOMED-CT"
        originalText="Imaging Procedure - Exam" />
        <ParticipantObjectID 12345678654321 />
        </ParticipantObjectIdentification>
740     <ParticipantObjectIdentification
        ParticipantObjectTypeCodeRole="4">
        <ParticipantObjectIDTypeCode csd-code="363679005121022" codeSystemName="DCM"
        originalText="Accession Number" />
745     <ParticipantObjectID 12345678901234 />
        </ParticipantObjectIdentification>
        </AuditMessage>"
    
```

```
}
]
}
```

750

#### 4.124.4.1.3 Expected Actions

The Receiver saves the events contained in the request payload and returns a response. The Receiver may perform other processing. The nature of that processing is not constrained by this transaction.

#### 755 4.124.4.2 HTTP POST Response

##### 4.124.4.2.1 Trigger Events

Receiver receives an HTTP POST Request.

##### 4.124.4.2.2 Message Semantics

The message is an HTTP POST Response.

760 The response syntax in ABNF (see RFC5234) is:  
 version SP status-code SP reason-phrase CRLF  
 \*(header-field CRLF)  
 CRLF  
 [Status Report]

##### 765 4.124.4.2.2.1 Status Codes

The response shall have an appropriate status code. Table 4.124.4.2.2.1-1 contains the most common status codes for this transaction. Any status code defined for HTTP transactions may be used.

**Table 4.124.4.2.2.1-1: Common Status Codes**

Status Code	Description
200 (OK)	Indicates that the origin server successfully stored or created at least one of the representations contained in the request payload and is returning a response payload.
201 (Created)	Indicates that the origin server successfully created at least one of the representations contained in the request payload and may be returning a response payload.
202 (Accepted)	Indicates that the origin server successfully validated the request message, but has not yet stored or created the representations in the request payload. The origin server may or may not have validated the payload. The user agent can use a Query or Retrieve transaction later to determine if the request has completed. E.g., using the Retrieve Syslog Message [ITI-82] transaction.

Status Code	Description
204 (No Content)	Indicates that the origin server successfully stored all the representations contained in the request payload without any modifications and is not returning a response payload.
400 (Bad Request)	Indicates that the origin server did not store any of the representations contained in the request payload because of errors in the request message. For example, an invalid encoding.
409 (Conflict)	Indicates that the request could not be completed due to a conflict with the current state of the target resource.

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#### 4.124.4.2.2.2 Response Header Fields

The HTTP response shall have the header fields as specified in Table 4.124.4.2.2.2-1 Response Header Fields.

**Table 4.124.4.2.2.2-1: Response Header Fields**

Header Field	Value Type	Usage	Description
Content-Type	media-type	C	Required if response contains a payload, shall contain "application/json"
Content-Encoding	encoding	C	Required if response payload has a content coding
Content-Length	int	C	Required if response payload does not have a content coding
Content-Location	uri	O	

775

#### 4.124.4.2.2.3 Response Payload

If the Receiver modified or failed to store any representations in the request payload, the response payload shall contain a Status Report describing any additions, modifications, or deletions to the stored representations. The Status Report may also describe any warnings or other useful information.

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#### 4.124.4.2.3 Expected Actions

There is no transaction specific behavior required for a response.

#### 4.124.5 Security Considerations

The use of TLS for this transaction should be supported, although specific location may choose not to configure it. The event reports might contain private information that must be protected.

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The event reporting systems are often targets of malicious attacks, so authentication protections such as TLS may be appropriate to protect the endpoints from attack. These systems using this transaction may need other special consideration and protection because they are a target for malicious attackers.

790 The use of TLS is not mandated because the protected information content has been minimized and event reports might not need protection in some jurisdictions. Similarly, the use of TLS to protect endpoints might be unnecessary because other protection mechanisms are in place.

795 The some of the security considerations from RFC5424 Syslog are also applicable to this transaction, especially those concerning message integrity (Section 8.7), message observation (Section 8.8), inappropriate configuration (Section 8.9), load considerations (8.11), and denial of service (Section 8.12).

#### **4.124.5.1 Security Audit Considerations**

There are no special audit considerations.



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# **Volume 3 – Cross-Transaction Specifications and Content Specifications**

## 4 IHE Namespaces, Concept Domains and Vocabularies

*Add new Section 4.3.2.1*

### 4.3.2.1 Codes for SOLE Profile

805 The following codes have been suggested for addition to the RadLex codes for SIIM Workflow Initiative in Medicine (SWIM™). They are shown as urn:ihe:rad codes, but will be replaced with RadLex codes when available.

**Table 4.3.2.1-1: New Codes to suggest to RadLex**

codeSystem	codeSystemName	Description	Definition
urn:ihe:rad	SOLE101	Order Filled	The procedure is scheduled.
urn:ihe:rad	SOLE102	Patient Arrived at Imaging	The patient checks-in at modality waiting area for the scheduled procedure
urn:ihe:rad	SOLE103	Resource Assigned	A resource, e.g., a specific imaging machine, device or imaging specialist, is assigned to a procedure.
urn:ihe:rad	SOLE105	QC Repeat Imaging Complete	Repeat images are acquired to replace images rejected by QC. Note: The rejection is a separate event - SOLE120 QC Reject.
urn:ihe:rad	SOLE106	Crit 2 Notification Closed	A category 2 finding (actionable in hours) is communicated to a physician taking care of patient. See Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group <a href="http://dx.doi.org/10.1016/j.jacr.2013.12.016">http://dx.doi.org/10.1016/j.jacr.2013.12.016</a>
urn:ihe:rad	SOLE107	Crit 3 Notification Delegated	A category 3 (days/months) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group <a href="http://dx.doi.org/10.1016/j.jacr.2013.12.016">http://dx.doi.org/10.1016/j.jacr.2013.12.016</a> ) is delegated.
urn:ihe:rad	SOLE113	Study transferred, e.g., priors	An exam transfer request, e.g., to transfer a prior study from PACS to an analysis system, has been completed.
urn:ihe:rad	SOLE112	Study requested, e.g., priors	A study transfer has been requested, e.g., to transfer a study from PACS to an analysis system.
urn:ihe:rad	SOLE114	Post-processing step started, e.g., CAD	A post processing step subsequent to data acquisition has started. This may be on the acquisition modality or another system.
urn:ihe:rad	SOLE115	Post processing step completed, e.g., CAD	A post processing step subsequent to data acquisition has complete. This may be on the acquisition modality or another system.

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codeSystem	codeSystemName	Description	Definition
urn:ihe:rad	SOLE116	Images Transferred	Images transferred to Image Manager/Image Archive, e.g., PACS.
urn:ihe:rad	SOLE117	Patient Study Merged	Multiple studies for a patient with 2 IDs are merged to 1 of the IDs
urn:ihe:rad	SOLE118	Study Merged	Multiple studies for a single patient are merged
urn:ihe:rad	SOLE119	QC Completed	Review images, adjust W/L, confirm correct patient, etc. Typically done by a technologist. There may also be a QC Reject if images are rejected.
urn:ihe:rad	SOLE120	QC Reject	QC rejects images. Typically done by a technologist.
urn:ihe:rad	SOLE121	Study Prefetch Requested	Priors or other relevant objects are requested to be transferred from PACS/Image Archives

810 The following codes are defined by IHE.

**Table 4.3.2.1-2: New IHE Codes defined for SOLE**

codeSystem	codeSystemName	Description	Role or Event
urn:ihe:rad	SOLE50	Appointment Resource	Role: The passive participant with this role is an appointment identification.
urn:ihe:rad	SOLE51	Location of Event	Role: The passive participant is the location at which an event has taken place.
urn:ihe:rad	SOLE52	Location Assigned	Role: The passive participant is the location for which an event has been assigned or planned.
urn:ihe:rad	SOLE53	Physician sending notification	Role: A physician that sends a critical notification.
urn:ihe:rad	SOLE54	Physician accepting notification	Role: A physician that receives a critical notification.
urn:ihe:rad	SOLE55	Human Scheduler	Role: A person that schedules procedures and resources
urn:ihe:rad	SOLE56	Admitting Staff	Role: Staff that handles patient admissions.
urn:ihe:rad	SOLE57	Transport	Role: A person responsible for transporting patients.
urn:ihe:rad	SOLE58	Order placer	Role: A system that accepts and manages orders
urn:ihe:rad	SOLE59	Order filler	Role: A system that manages order fulfilment
urn:ihe:rad	SOLE60	Automatic Scheduler	Role: A system that automatically schedules procedures and resources
urn:ihe:rad	SOLE61	Automatic Admitting System	Role: A system that lets patients automatically handle admission.
urn:ihe:rad	SOLE62	EMR	Role: A system that manages electronic medical records for an organization.

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<b>codeSystem</b>	<b>codeSystemName</b>	<b>Description</b>	<b>Role or Event</b>
urn:ihe:rad	SOLE63	PACS	Role: A system that manages images and associated data for an organization.
urn:ihe:rad	SOLE64	RIS	Role: A system that manages information flow and operations for an imaging department.
urn:ihe:rad	SOLE65	Imaging Workstation	Role: A system used for viewing images and related functions such as reporting.
urn:ihe:rad	SOLE66	Image Archive	Role: A system used for archival storage of images and associated data.
urn:ihe:rad	SOLE67	Imaging Operational Event	Event: An imaging event defined for reporting or tracking.

## 6 IHE Radiology Content Specifications

815 *Add new Section 6.3 and subsections.*

### 6.3 SOLE Event Definitions

The events described in SIIM Workflow Initiative in Medicine (SWIM™) <http://siim.org/resource/resmgr/swim/SWIMRadlex1.xlsx> are reported as SOLE event reports.

820 The semantic content to be included in the report is defined in Section 6.3.2 Event Semantics, and Section 6.3.3.1 Encoding an Event Report.

#### 6.3.1 SWIM and SOLE Event selection

825 The SWIM lexicon was developed as a comprehensive list of all events that might occur in an imaging department. However, many of these are not easily captured by systems that exist today, or the effort to report the events would far outweigh the perceived value. The events were also selected to cover a broad range of event types in order to assure broad utility and to assure the methods selected in the SOLE Profile would not impede future inclusion of the rest of the SWIM lexicon. Finally, events that are considered highly valuable based on current business intelligence systems were also identified and included in the list.

#### 6.3.2 Event Semantics

The baseline events are selected from the RadLex SWIM list, <https://github.com/ImagingInformatics/SWIM-Events>. This list may be extended by local policy with other events from the RadLex SWIM list, or by locally defined events.

835 Note: For some events, IHE has requested changes to Event Code Values and /or Event Definitions defined in RadLex at the time of publication of this SOLE Trial Implementation Supplement. These requested changes are included in Column 1 and 2 with markup. Column 5 contains the rationale for the requested change. It is expected that future revisions of SOLE will contain updated RadLex codes.

**Table 6.3.2-1: Baseline SOLE Events**

Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Order Entered RID45813	The physician ordered the procedure and entered into order placer system	At least one shall be present: Automated order management (0..1) [Machine] Ordering Physician (0..1) [Person]  Order number (1..1) [Object] Study (1..n) [Object]	Consistency with existing IHE terminology.

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Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Appointment Time Scheduled RID45814	The scheduler set the Appointment Time for the study	At least one shall be present: Human Scheduler (0..1) [Person] Automated scheduler (0..1) [Machine]  Study (1..1)[Object] Order number (1..1)[Object] Accession Number (0..1)[Object]	Align with DICOM terminology
Order Filled SOLE101	The procedure is scheduled.	At least one shall be present: Automated order management (0..1) [Machine] Ordering Physician (0..1)[Person]  Order number (1..1)[Object] Accession Number (1..1)[Object]	
Patient Arrived RID45825	The patient checks-in at a general admitting desk at imaging facility	Admitting Staff (0..1) [Person] Automatic Check In System (0..1) [Machine] Patient (1..1)[Patient] Arrival Location (1..1)[Location]	
Patient Arrived at Imaging SOLE102	The patient checks-in at modality waiting area for the procedure	Admitting Staff (0..1) [Person] Automatic Check In System (0..1) [Machine] Patient (1..1)[Patient] Arrival Location (1..1)[Location]	
Room Assigned RID45934	The room is assigned to a procedure Note: This is for situations where specific rooms are assigned. It is not for assignment of generic resources, e.g., "one of the CTs".	At least one shall be present: Human Scheduler (0..1) [Person] Automated Scheduler (0..1) [Machine]  Study(1..1)[Object] Room Location (1..1)[Location]	
Resource Assigned SOLE103	A resource, e.g., a specific imaging machine, device or imaging specialist, is assigned to a procedure. Note: This is for situations where specific identifiable resources are assigned. It is not for assignment of generic resources, e.g., "one of the CTs".	At least one shall be present: Human Scheduler (0..1) [Person] Automated scheduler (0..1) [Machine]  Study (1..1)[Object] Resource (1..1)[Resource]	

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Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Patient In RID45897	The patient enters the procedure room	Room Location (1..1)[Location] Transport (0..1)[Person] Study (0..1)[Object] Patient (0..1) [Person]  See Note 1.	
Patient Out RID45899	The patient leaves the procedure room	Transport (0..1)[Person] Patient (1..1) [Person] Study (0..1)[Object] Room Location (1..1)[Location]  See Note 1.	
Data Acquisition Started RID46000	The imaging device begins to collect data	Imaging Modality (1..1)[Machine] Technologist (0..1)[Person] Patient (0..1) [Person] Study (1..1)[Object]  See Note 1.	
Base Imaging Complete RID45835	All images are acquired See Note 2.	Imaging Modality (1..1)[Machine] Technologist (0..1)[Person] Study (1..1)[Object]	There were many issues regarding what constitutes base images, optional reconstructions, latter reconstructions, etc. Modalities each have internal rules and found "images acquired" clearer and interpreted it as "the usual images and reconstructions for this kind of exam study".
Imaging Complete RID45847	All images are acquired and reconstructed (including routine special reconstructions done on the imaging device) on the imaging device	Imaging Modality (1..1)[Machine] Technologist(0..1)[Person] Study (1..1)[Object]	
Post Processing Started SOLE114	Post-processing step started, e.g., CAD.	Imaging Modality, Analysis System (1..1)[Machine] Technologist(0..1)[Person] Study(1..1)[Object]	
Post Processing Complete SOLE115	A post-processing step completed, e.g., CAD.	Imaging Modality, Analysis System (1..1)[Machine] Technologist(0..1)[Person] Study (1..1)[Object]	

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Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Study Prepared RID45914	All steps required for reporting completed (images acquired, transmitted to reporting device, post-processing done) e.g., Study put onto reading or QC worklist.	QC Workstation (1..1)[Machine] Technologist (0..1)[Person] Study (1..1)[Object]	Align with DICOM terminology
Images Transferred SOLE116	Images transferred to Image Manager/Image Archive, e.g., PACS.	Imaging Modality (0..1)[Machine] Image Archive (1..1) [Machine] Technologist (0..1)[Person] Study (1..1)[Object]	
QC Completed SOLE119	Delete unacceptable images, adjust W/L, confirm correct patient, etc. Typically done by a technologist.	QC Workstation (1..1)[Machine] Technologist(0..1)[Person] Study (1..1)[Object]	
QC Reject SOLE120	QC rejects images. Typically done by a technologist.	QC Workstation (1..1)[Machine] Technologist(0..1)[Person] Study (1..1)[Object]	
QC Repeat Ordered SOLE105	Reject/repeat ordered for the QC rejected images.	QC Workstation (1..1)[Machine] Technologist (0..1)[Person] Study (1..1)[Object]	
Crit 1 Notification Closed RID45854	A category 1 (minutes) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group <a href="http://dx.doi.org/10.1016/j.jacr.2013.12.016">http://dx.doi.org/10.1016/j.jacr.2013.12.016</a> ) is communicated to a physician taking care of patient.	Physician (2..2)[Person] (one sending and one receiving) Study (1..1)[Object]	
Crit 2 Notification Closed SOLE106	A category 2 (hours) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group <a href="http://dx.doi.org/10.1016/j.jacr.2013.12.016">http://dx.doi.org/10.1016/j.jacr.2013.12.016</a> ) is communicated to a physician taking care of patient.	Physician (2..2)[Person] (one sending and one receiving) Study (1..1)[Object]	



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Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Crit 3 Notification Delegated SOLE107	A category 3 (days/months) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group <a href="http://dx.doi.org/10.1016/j.jacr.2013.12.016">http://dx.doi.org/10.1016/j.jacr.2013.12.016</a> ) is delegated.	Physician (1..2)[Person] (one sending and optionally one receiving) Study (1..1)[Object]	
Report Dictated RID45859	Physician reviews image and renders a report in electronic audio format	Physician (1..1)[Person] Study (1..1)[Object]	
Report Approved RID45924	Final text form report is approved (signed)	Physician 1..1)[Person] Study (1..1)[Object]	
Report Available RID45850	Final report and study is available to ordering physician	EMR/PACS/RIS (1..n)[Machine] Study(1..1)[Object]	Align with DICOM terminology
Report Sent RID45865	Final report and study is sent to ordering physician (EMR confirmation of receipt)	EMR/PACS/RIS (1..n)[Machine] Study (1..1)[Object]	Align with DICOM terminology
Study Archive Commit RID45871	Study is transferred to an external archive or long term storage	Image Archive (1..n)[Machine] Study (1..1)[Object]	Align with DICOM terminology
Study Transfer To Billing RID45836	Complete billing information on study has been transferred to billing system	EMR (1..1)[Machine] Study(1..1)[Object]	Align with DICOM terminology
Patient Merged RID45898	The EMR has merged a patient with 2 IDs are merged to 1 of the IDs	EMR (1..1)[Machine] Study (0..n) [Object] Patient (2..n)[Patient]	
Patient Study Merged SOLE117	Multiple studies for a patient with 2 IDs are merged to 1 of the IDs	PACS/RIS /EMR (1..1)[Machine] Study (2..n) [Object] Patient (1..n)[Patient]	
Study Merged SOLE118	Multiple studies for a single patient are merged	PACS (1..1)[Machine] Study (2..n) [Object] Patient (1..1)[Patient]	
Study Reassigned RID45863	Change the patient ID for a study to a different patient ID (e.g., trauma patient ID reconciliation)	PACS/RIS/EMR (1..1)[Machine] Staff (0..n)[Person] Study (1..n) [Object] Patient (2..n)[Patient]	Align with DICOM terminology

Name and Event Code	Definition: "The time when:"	Participants	Change requested of RadLex
Study_Removed RID45856	The study_and any associated images are deleted (or made unavailable)	PACS/RIS/EMR (1..1)[Machine] Staff (0..n)[Person] Study (1..1) [Object]	Align with DICOM terminology
Study_Opened For Reporting RID45893	The study_is opened on viewing application by the radiologist for reporting	PACS/RIS/EMR/Imaging Workstation (1..1)[Machine] Physician (0..1)[Person] Study (1..1)[Object]	Align with DICOM terminology
Study_Cancelled RID45862	The study is cancelled either before, during, or after the acquisition. See Note 2.	PACS/RIS/EMR/Workstation (1..1)[Machine] Staff (0..n)[Person] Study (1..1)[Object]	Align with DICOM terminology
Study Prefetch Requested SOLE112	Priors or other relevant objects are requested to be transferred to PACS/Image Archives	PACS/RIS/EMR/Workstation (1..n)[Machine] Staff (0..n)[Person] Study (1..1)[Object]	
Study Transferred SOLE113	Study transferred, e.g., priors	PACS/RIS/EMR/Workstation (1..n)[Machine] Staff (0..n)[Person] Study(1..1)[Object]	
Study_Prefetch Completed RID45907	Priors or other relevant objects have been transferred from_PACS/Image Archives.	PACS /Image Archive(1..n)[Machine] Study (1..1)[Object]	Align with DICOM terminology

840 Note 1: Most SOLE events avoid identifying the patient and instead identify the exam. These three events identify the patient. The PatientIn and PatientOut events may be provided by a patient movement tracking systems, e.g., RFID system, that is not aware of the patient exam. The DataAcquisitionStarted event may identify the patient to provide the linkage between the patient and the exam. For these events at least one of the participants exam or patient must be present.

845 Note 2: The strikeout text is a change suggested to RadLex. It was not yet agreed to by RadLex at time of publication. When revised text is provided, this text will be updated.

### 6.3.3 Event Reports

Event reports sent in Syslog messages shall set APP-NAME to "IHE+SOLE" and MSG-ID to the EventTypeCode, e.g., "RID45859".

Event reports shall be encoded in accordance with the schema in DICOM PS3.15 Section A.5.

#### 850 6.3.3.1 Encoding an Event Report

The basic elements of an event report in the DICOM schema are:

- The event element captures the kind of event and the time it happened.
- The active participant elements captures the usual identification methods for machines, applications, network endpoints, and staff.

- 855
- The passive participant elements captures the usual identification methods for documents, patients, visitors, locations, etc.
  - The audit source element captures the identification for the observer that recorded the event.

These are then extensible to accommodate specific needs for specific purposes.

860 The tables below define the encoding of the event (Table 6.3.3.1-1), the audit source (Table 6.3.3.1-2), and the one or more participants. For a given event, a participant is one of:

- Machine (Table 6.3.3.1-3)
- Person performing action (Table 6.3.3.1-4)
- Object (Table 6.3.3.1-5)
- Resource (Table 6.3.3.1-6)
- Location (Table 6.3.3.1-7)
- Patient (Table 6.3.3.1-8)

In Table 6.3.2-1, each participant indicates which of the participant tables below describes the participant."

870 **Table 6.3.3.1-1: Event Report Fields**

	Field Name	Opt	Value Constraints
<b>Event</b> AuditMessage/ EventIdentification	EventID	M	EV(SOLE67, urn:ihe:rad, "Imaging Operational Event")
	EventDateTime	M	not specialized (DICOM PS3.15 Section A.5)
	EventOutcomeIndicator	M	not specialized (DICOM PS3.15 Section A.5)
	EventTypeCode	M	DCID (Table 6.3.2-1 Baseline SOLE Events), Note: Multiple EventTypeCodes are permitted.
	Comment	U	
Audit Source (1..1)			
Machine Participant (0..n)			
Person Participant (0..n)			
Object Participant (0..n)			
Resource Participant (0..n)			
Location Participant (0..n)			
Patient Participant (0..n)			

**Audit Source** is the system that detected and reported the event.

**Table 6.3.3.1-2: Audit Source Encoding**

<b>Audit Source</b> AuditMessage/ AuditSourceIdentification	<b>Field Name</b>	<b>Opt</b>	<b>Value Constraints</b>
	<i>AuditSourceID</i>	<i>M</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	<i>AuditEnterpriseSiteID</i>	<i>U</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	<i>AuditSourceTypeCode</i>	<i>U</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>

875 **Machine participants** are machines, software, applications, etc., that actively participate in the event, e.g., Modality or Image Archive.

**Table 6.3.3.1-3: Machine Participant Encoding**

<b>Machine Participant</b> AuditMessage/ ActiveParticipant	<b>Field Name</b>	<b>Opt</b>	<b>Value Constraints</b>
	UserID	M	Primary identity of the machine participant, e.g., process ID, AE title, etc.
	AlternativeUserID	U	A second identity of the machine participant, e.g., process ID, AE title, etc.
	<i>UserName</i>	<i>U</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	RoleIDCode	M	See Section 6.3.4.2
	NetworkAccessPointTypeCode	M	"1" for machine name, "2" for IP address
	NetworkAccessPointID	M	The machine name (in DNS) or IP address.
	ParticipantObjectDetail	U	"Function=<name-of-function>"  ParticipantObjectDetail identifies the participating internal functions when the machine has multiple functions and not all participated in the event. e.g., "Function=CAD", "Function=Joe Algorithm"

880 **Person Participants** are staff that actively participate in the event, e.g., Radiologist or Technologist.

**Table 6.3.3.1-4: Person Participant Fields**

<b>Person Participant</b> AuditMessage/ ActiveParticipant	<b>Field Name</b>	<b>Opt</b>	<b>Value Constraints</b>
	UserID	M	One identity of the human that participated in the transaction, e.g., Employee Number.
	AlternativeUserID	U	A second identity of the human that participated in the transaction, e.g., NPI (US).
	<i>UserName</i>	<i>U</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>

	<i>UserIsRequestor</i>	<i>U</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	RoleIDCode	M	See Section 6.3.4.1
	Department	U	See Section 6.3.4.4 Departments
	Shift	U	See Section 6.3.4.5 Shift

**Object Participants** are software and conceptual objects, e.g., “order”, "study" and "report".

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**Table 6.3.3.1-5: Object Participant Encoding**

<b>Object Participant</b> (AuditMessage/ ParticipantObject)	<b>Field Name</b>	<b>Opt</b>	<b>Value Constraints</b>
	ParticipantObjectTypeCode	M	"2" (system object)
	ParticipantObjectTypeCodeRole	M	“3” (Report – for a study or a report) “20” (Job – for an order)
	<i>ParticipantObjectID</i>	<i>M</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	ParticipantObjectIDTypeCode	M	See Section 6.3.4.3 for Participant Object ID Type Codes

**Resource participants** are rooms, assigned machines, etc. that are the objects of actions.

**Table 6.3.3.1-6: Resource Participant Encoding**

<b>Resource Participant</b> (AuditMessage/ ParticipantObject)	<b>Field Name</b>	<b>Opt</b>	<b>Value Constraints</b>
	ParticipantObjectTypeCode	M	"2" (system object)
	ParticipantObjectTypeCodeRole	M	See Section 6.3.4.3, participating object roles
	<i>ParticipantObjectID</i>	<i>M</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>
	<i>ParticipantObjectIDTypeCode</i>	<i>M</i>	<i>not specialized (DICOM PS3.15 Section A.5)</i>

890 **Location participants** are locations where events have taken place or activities are scheduled, e.g., "Room 101". There are standard codes for geographic locations and addresses, but not for the internal room naming system within the imaging facility. The location is identified by setting two of the name-value pairs in the ParticipantObjectDetail. A name for the location encoding shall be specified, e.g., "St. Mary’s of Boston Clinic Rooms", and the name for the location  
895 within that encoding shall be specified, e.g., "Grant CT Suite A".

**Table 6.3.3.1-7: Location Participant Encoding**

Location Participant	Field Name	Opt	Value Constraints
(AuditMessage/ ParticipantObject)	ParticipantObjectTypeCode	M	"3" (Organization)
	ParticipantObjectTypeCodeRole	M	"2" (Location)
	ParticipantObjectID	M	not specialized (DICOM PS3.15 Section A.5)
	ParticipantObjectIDTypeCode	M	EV(SOLE51,urn:ihe:rad,"Location of Event") or EV(SOLE52, urn:ihe:rad, "Location assigned")
	ParticipantObjectDetail	M	"Location"=<location-value-string> "Location-encoding"=<name-for-location-encoding>

Patient participants are the patients.

**Table 6.3.3.1-8: Patient Participant Encoding**

Patient Participant	Field Name	Opt	Value Constraints
(AuditMessage/ ParticipantObject)	ParticipantObjectTypeCode	M	"1" (person)
	ParticipantObjectTypeCodeRole	M	"1" (patient)
	ParticipantObjectSensitivity	U	not specialized (DICOM PS3.15 Section A.5)
	ParticipantObjectID	M	the patient ID in HL7 CX format.
	ParticipantObjectIDTypeCode	M	EV(121025, DCM, "Patient")

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## 6.3.4 Coded Terminologies

### 6.3.4.1 Person participant roles

The RoleIDCode for a Person Participant in an event describes the nature of their participation in that event. This is different than an organizational role. A surgeon that refers a patient for an exam would have an organizational role of surgeon and a participant role of referring physician.

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#### 6.3.4.1.1 DICOM CID 7450

The DICOM CID 7450 has a list of potential person roles. It includes further lists of family member and organizational roles. These may be used as the role for a person in a SOLE event. It is reproduced here for convenience.

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**Table 6.3.4.1.1-1: DICOM Table CID 7450. Person Roles**

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
DCM	121025	Patient		
SRT	J-00552	Healthcare professional	223366009	C1704312
SRT	S-11090	Friend	113163005	C0079382
<i>Include CID 7451 "Family Member"</i> <a href="http://dicom.nema.org/medical/dicom/current/output/html/part16/sect_CID_7451.html">http://dicom.nema.org/medical/dicom/current/output/html/part16/sect_CID_7451.html</a>				
<i>Include CID 7452 "Organizational Roles"</i> <a href="http://dicom.nema.org/medical/dicom/current/output/html/part16/sect_CID_7452.html">http://dicom.nema.org/medical/dicom/current/output/html/part16/sect_CID_7452.html</a>				

### 6.3.4.1.2 Additional Roles

The following additional roles may be used in SOLE messages.

**Table 6.3.4.1.2-1: Additional Roles for SOLE Messages**

Coding Scheme Designator	Code Value	Code Meaning
DCM	121096	Ordering Physician
urn:ihe:rad	SOLE53	Physician sending notification
urn:ihe:rad	SOLE54	Physician accepting notification
urn:ihe:rad	SOLE55	Human Scheduler
urn:ihe:rad	SOLE56	Admitting Staff
urn:ihe:rad	SOLE57	Transport Staff

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### 6.3.4.2 Machine Roles

The following machine roles should be used for devices that are active participants in an event. If this list lacks a suitable code, a locally defined code may be used.

**Table 6.3.4.2-1: Device Participating Roles**

Coding Scheme Designator	Code Value	Code Meaning
DCM	113859	Irradiating Device
DCM	121097	Recording

Coding Scheme Designator	Code Value	Code Meaning
DCM	113942	X-Ray Reading Device
urn:ihe:rad	SOLE58	Order Placer
urn:ihe:rad	SOLE59	Order Filler
urn:ihe:rad	SOLE60	Automatic Scheduler
urn:ihe:rad	SOLE61	Automatic Admitting System
RadLex	RID10311	Modality (generic)
urn:ihe:rad	SOLE62	EMR
urn:ihe:rad	SOLE63	PACS
urn:ihe:rad	SOLE64	RIS
urn:ihe:rad	SOLE65	Workstation
urn:ihe:rad	SOLE66	Archive

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### 6.3.4.3 Object ID Type Codes

The following object roles should be used for objects that participate in an event. If this list lacks a suitable code, a locally defined code may be used.

**Table 6.3.4.3-1: Participating Object Roles**

Coding Scheme Designator	Code Value	Code Meaning
urn:ihe:rad	SOLE50	Appointment
urn:ihe:rad	SOLE51	Location of Event
urn:ihe:rad	SOLE52	Location assigned
SNOMED	363679005	Imaging Procedure - Exam
SNOMED	371524004	Clinical Report
DCM	121021	Filler Number
DCM	121022	Accession Number

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### 6.3.4.4 Department

Department is an additional string element that is added to the AuditMessage/ParticipantObject. It can be used to convey a departmental location for a person when that person is participating in



930 an event that is not in the usual location for that person. For example, when a cardiologist that is normally in the Cardiology Department is involved in an event taking place in the Emergency Department, this element can be used to indicate the different location.

There is no suitable international standard for the contents of this string. The names of local departments are highly variable, and the selection of which departments should be tracked is variable.

935 **6.3.4.5 Shift**

Shift is an additional string element that is added to the AuditMessage/ParticipantObject. It can be used to convey a shift identifier for a person. This can be useful when tracking the handoff between shifts. There is no suitable international standard for the names of shifts. The contents of this string will be determined by the local policies.