Integrating the Healthcare Enterprise

IHE Radiology
Technical Framework Supplement

Standardized Operational Log of Events (SOLE)

Rev. 1.0 – Draft for Public Comment

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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

This is a supplement to the IHE Radiology Technical Framework 15.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into
30   the volumes of the Technical Frameworks.

This supplement is published on March 17, 2017 for public comment. Comments are invited and can be submitted at http://www.ihe.net/Radiology_Public_Comments. In order to be considered in development of the trial implementation version of the supplement, comments must be received by April 16, 2017.

35   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.

Amend Section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment
40   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.

General information about IHE can be found at www.ihe.net.

45   Information about the IHE Radiology domain can be found at ihe.net/IHE_Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at http://ihe.net/IHE_Process and http://ihe.net/Profiles.

The current version of the IHE Radiology Technical Framework can be found at http://www.ihe.net/Technical_Frameworks.

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CONTENTS

Introduction to this Supplement

This supplement adds a profile for operational event reporting. It adds a profile section to
135 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

Number	Issue
2	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)? The intention is to harmonize additional events with SWIM. *Preliminary list selection done in F2F number one. See Section 6.X (volume 3)* *(17 Feb) "Critical Result discovered" added to the list.* *(3 March) Additional events added during discussion*
5	Should this profile add the RESTful POST of syslog messages that was proposed for ITI this year? It wasn't ranked high enough for ITI, and was thought small enough that perhaps a CP was the right approach rather than a supplement. This has two potential uses: - 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. - 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. The alternative is to set up and then take down syslog connections. *Included for PC and decide then. 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.* *We need feedback from ITI as part of PC.*
7	Are the right events defined and will the total total event flow remain acceptable for traffic limits of syslog? Review list in Section 6.X and consider what the volume will be like in realistic large environments.
8	Should mobile sources be supported in first round using RAD-XX transaction? Eliminates need to establish solution for the mobile devices that will not support syslog. **YES – If ITI concurs with the approach and is likely to use this for ATNA.**
12	(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®[1] 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. An alternative is to have specific options for various kinds of events.
15	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?

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[1] CDA is the registered trademark of Health Level Seven International.

Number	Issue
	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, … ?
18	Patient Participant includes ParticipantObjectSensitivity for VIPs, etc. Is this level of detail appropriate?
19	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?
20	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?
22	How should the list of events that can an implementation can detect and report be documented for the purchaser of an implementation?

140 # Closed Issues

Number	Issue
1	Should the transport be Syslog, as it is in ATNA?
	Conclusion: Syslog and ATNA compatibility remain the correct choice.
	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.
	1. Existing technologies in use for event logging
	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.
	Syslog
	This protocol has reached standardization, and it's what DICOM®[2] 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:
	1. 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.
	2. 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.

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[2] DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

Number	Issue
	3. 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. **Journalctl** 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, 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. 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: - 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. - 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. - 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. 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. 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. **No – because this is not likely to be used outside of Linux.** **Flume** 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. **It's a Java only library** 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.) **There is no official standard organization responsible for this logging system.** **Bitcoin/Blockchain** 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. 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. **There is no official standard organization responsible for this logging system.**

Number	Issue
	The high computational burden and connectivity requirements make it unattractive. *The survival of logs in the face of corrupt, defective, and malicious nodes is of value.* 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. **Android/Ios (phone/tablet use)** 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. This other method is typically able to send large blocks of event reports efficiently. 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. **A bulk event transfer transaction is proposed to deal with this. RAD-XX. This remains a risk issue until ITI confirms that they will use this.** **MQTT (Oasis)** 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. MQTT is standardized as an OASIS standard http://docs.oasis-open.org/mqtt/mqtt/v3.1.1/os/mqtt-v3.1.1-os.pdf
3	Should the message be encoding different than the DICOM Audit Schema be used? **No - The profile assumes use of the DICOM Audit Schema so that ATNA tooling can be re-used**.
4	*Removed, editorial instructions not a comment issue*
6	Are the RESTful Syslog query parameters sufficient? Are additional query parameters needed? 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. 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. The bulk of event selection and analysis is performed within the Event Consumer. See Section 4.1.3 for details of basic query capability.
9	We will not capture patient prep times in detail. In general, the time from arrival to procedure room is treated as one activity. Most automatic systems do not collect details within this activity. They cannot distinguish between transport time, time in waiting rooms, and clinical preparation time.
10	*Duplicate of 5, merged into 5*
11	A requirement for NTP on mobile devices may be hard to meet. Should this ATNA requirement be relaxed and rephrased? 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.

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. **Close for RAD, move to ITI. Need to have the same answer for all CT devices.**
13	This profile will not cover activities subsequent to completion and delivery of the imaging report. The total list of events in SWIM does extend further, and it could be enhanced with more events for that purpose. That will be the scope of some other profile.
14	Should SOLE also use the "IHE+RFC3881" identifier or use a distinct identifier "IHE+SOLE"? One reason to use IHE+SOLE would be 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.
16	This proposes an "IHE+SOLE" EventID in the Syslog headers, so that combined events can be reported by multiple EventTypeCodes in the MSG-ID.
17	Should offset and limit support be mandatory? **Yes –** **see RFC-7233**
21	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? **YES, changed to generic names**

General Introduction

Update the following appendices to the General Introduction as indicated below. Note that these are not appendices to Volume 1.

Appendix A – Actor Summary Definitions

145

Add the following actors to the IHE Technical Frameworks General Introduction list of Actors:

Actor	Definition
Event Reporter	The Event Reporter composes and sends event reports to other actors.
Event Consumer	The Event Consumer processes event reports. It may either receive event reports or query for event reports.
Event Repository	The Event Repository receives and manages event reports.

Appendix B – Transaction Summary Definitions

150

Add the following transactions to the IHE Technical Frameworks General Introduction list of Transactions:

Transaction	Definition
Transfer Multiple Event Reports [RAD-Y1]	Delivers a payload of many event reports as a single RESTful HTTP Put transaction.

Glossary

Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

155   None.

Volume 1 – Profiles

Add Section X

160

X Standardized Operational Log of Events (SOLE) Profile

Efficient businesses use business intelligence tools to manage their business. The application of these tools to manage medical care has been limited in part because the information often resides in several different systems, and there are not standard ways to obtain the information. The SOLE Profile defines a way to exchange information about events that can then be collected, analyzed and displayed using standard methods.

Healthcare providers have a strong desire to increase throughput and efficiency, both to improve the quality and timeliness of care and to control costs. Such process improvement efforts depend on being able to capture workflow events and apply business intelligence tools. Such initiatives face several problems:

- Event information that is to be logged comes from many different systems but there is no easy way to compile the event reports into a single collection

- The different systems recording the particular events being reported may have different understandings of the definition of the event, time point or measurement; the result is:

    - Within a single institution, data is non-uniform across systems, degrading the value of the information

    - Across institutions, it is hard to compare to evaluate best practices

X.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 http://ihe.net/Technical_Frameworks.

Figure X.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.
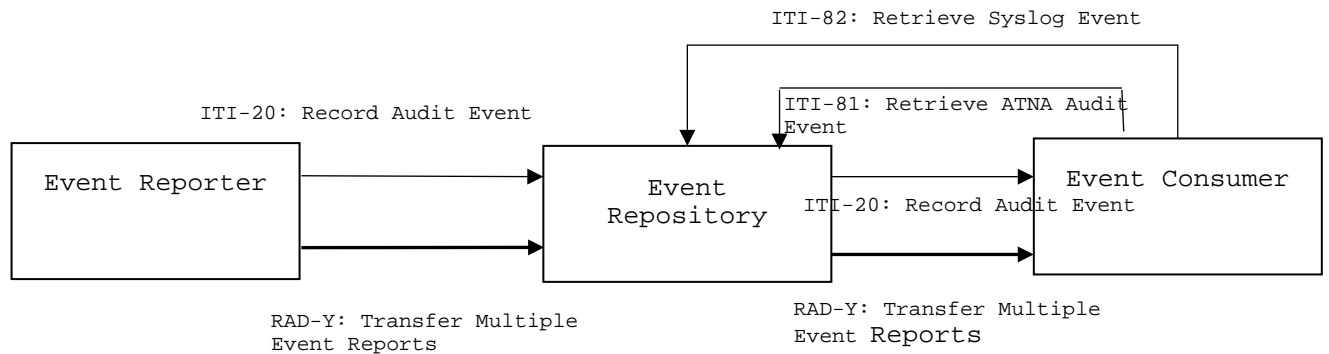
Figure X.1-1: SOLE Actor Diagram

190

Table X.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").

195 **Table X.1-1: SOLE Profile - Actors and Transactions**

Actors	Transactions	Optionality	Reference
Event Reporter	Record Audit Event [ITI-20]	R	ITI TF-2a: 3.20
	Transfer Multiple Event Reports [RAD-Y]	O	RAD TF-3: 4.Y
Event Repository (Note 1)	Record Audit Event [ITI-20]	R	ITI TF-2a: 3.20
	Transfer Multiple Event Reports [RAD-Y]	R	RAD TF-3: 4.Y
	Retrieve Syslog Event [ITI-82]	R	ITI TF-2c: 3.82
	Retrieve ATNA Audit Event [ITI-81]	R	ITI TF-2c: 3.81
Event Consumer	Record Audit Event [ITI-20]	O	ITI TF-2a: 3.20
	Transfer Multiple Event Reports [RAD-Y]	O	RAD TF-3: 4.Y
	Retrieve Syslog Event [ITI-82]	R	ITI TF-2c: 3.82
	Retrieve ATNA Audit Event [ITI-81]	O	ITI TF-2c: 3.81

Note 1: The Event Repository is required to implement [ITI-20] and [RAD-Y] as both the Sender and the Receiver.

Table X.1-2: SOLE Profile - Actors and Content Modules

Actors	Content Modules	Optionality	Reference
Event Reporter	SOLE Event	R	RAD TF-3: 6.X SOLE Event Definitions
Event Repository	SOLE Event	R	RAD TF-3: 6.X SOLE Event Definitions

Actors	Content Modules	Optionality	Reference
Event Consumer	SOLE Event	R	RAD TF-3: 6.X SOLE Event Definitions

X.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.

X.1.1.1 Event Reporter

Event Reporters shall be able to report all events in RAD TF-3: Table 6.X.2-1 Baseline SOLE Events that occur on the Event Reporter and grouped actors. The Event Reporter should document which events it can detect and report.

SOLE Events shall be reported using Syslog events that comply with the SOLE Event Content Module definition.

The Event Reporter shall be configurable as to the events to be reported, and the location or locations 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.

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

X.1.1.2 Event Repository

Event Repository shall be able to store all event reports in RAD TF-3: Table 6.X.2-1 Baseline SOLE Events. The Event Repository shall be able to remove event reports after a configurable period of time.

The Event Repository shall be configurable to support filtering and forwarding event reports to other Event Repositories or Event Consumers. See RAD TF-1: X.4.1.3.

The Event Repository shall not generate an error for messages complying with the Syslog RFCs.

Note: This means that an Event Repository will not generate an error when it receives a Syslog RFC-compliant event report with a malformed SOLE payloads.

X.1.1.3 Event Consumer

An Event Consumer shall be able to receive any SOLE event report, RAD TF-3: Table 6.X.2-1 Baseline SOLE Events. It might only process a subset of the SOLE event reports, and might receive and process other types of event reports.

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

230 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.

X.2 SOLE Actor Options

Options that may be selected for each actor in this profile, if any, are listed in Table X.2-1.
235 Dependencies between options when applicable are specified in notes.

Table X.2-1: Standardized Operational Log of Events - Actors and Options

Actor	Option Name	Reference
Event Reporter	Multiple Events Option	Section X.2.1
Event Consumer	Multiple Events Option	Section X.2.1
	Retrieve ATNA Audit Event Option	Section X.2.2

X.2.1 Multiple Event Option

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

X.2.2 Retrieve ATNA Audit Event Option

An Event Consumer that supports the Retrieve ATNA Audit Event shall be able to use the
250 Retrieve ATNA Audit Event [ITI-81] transaction to obtain event reports.

X.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).

255 It is important that the time base for all of the actors be the same. The Event Reporter and Event Consumer shall be grouped with the Time Client for this reason.

Table X.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	ITI TF-1: 2.2.7	--
Event Consumer	Consistent Time / Time Client	ITI TF-1: 2.2.7	--

260 ## X.4 SOLE Overview

X.4.1 Concepts

The SIIM Workflow Initiative in Medicine (SWIM™) 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

265   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

X.4.1.1 Events and extending events

SOLE has defined a short list of events of interest that take place during the imaging process at
270 imaging departments. This list can be found in RAD TF-3: Table 6.X.2-1 Baseline SOLE Events. This list is being coordinated with the RADLEX SWIM.

The RADLEX SWIM initiative has defined and maintains a large list of events that take place in the imaging departments. The full list of events defined by SWIM can be found at http://siim.org/resource/resmgr/swim/SWIMRadlex1.xlsx.

275 The baseline SOLE events will be understood by all SOLE actors.

A deployment may extend the list of events reported for local purposes by extending the baseline SOLE list with reports for other events in the SWIM list. These additional event report types are more likely to be interoperable and understood by other implementations.

New event reports types that are not defined by SWIM are best handled by coordinating with
280 SWIM to get those events incorporated into the SWIM definition.

Local extensions to the event types reported will not generate errors, but are less likely to be interoperably supported.

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 an RIS based
285 on the MPPS contents and the Series contents of the associated DICOM images. This may be

used to accommodate the transition from old systems that do not events to new systems that report events.

X.4.1.2 Retrieving Event Reports

The Event Consumer can retrieve data for analysis by using either of the two event report
290 retrieval transactions defined by ITI. They are summarized below.

X.4.1.2.1 Retrieve Syslog Message [ITI-82]

The Retrieve Syslog Message [ITI-82] retrieves all syslog messages that match query parameters against the mandatory Syslog header fields. This retrieves syslog messages regardless of the message body format, so it can retrieve any valid Syslog message. A very common query is to
295 specify only a time range and APP-NAME to get all SOLE events for a given time period.

Table X.4.1.2.1-1: Retrieve Syslog Event Keys

Syslog RFC 5424 element	Retrieve Syslog Event 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	Identification for kind of message. IHE has specified "IHE+SOLE" for SOLE event reports. The event reports from other sources and other profiles will also be retrieved, e.g., "ATNA+3881", if this is not used for filtering.
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.

See ITI TF-2c: 3.82.

300 ### X.4.1.2.2 Retrieve ATNA Audit Event [ITI-81]

The Retrieve ATNA Audit Event [ITI-81] transaction supports searches based on:

- **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,
305 etc.).

- **Time frame**: for event reports that occurred during a specific time frame.

- **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.

310
- **Event Outcome Indicator**: for event reports characterized by a specific outcome (Success, Failure, etc.).

These retrievals are based on using the FHIR®[3] Audit Record Resource and performing a constrained set of FHIR queries. It returns a set of FHIR resources, per FHIR formatting.

See ITI TF-2c: 3.81.

X.4.1.3 Filter and Forward

315

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
320 of the detailed contents of the event reports.

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 ATNA Profile, proprietary database events, facility maintenance events, etc. All of these can use
325 syslog and the Event Repository.

The Filtering and Forwarding permit the event repository to be configured to selectively forward these event reports on to multiple event consumers and event repositories. Syslog event streams like selected ATNA (e.g., user login) 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
330 to the security office for use by the security system dashboard.

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
335 is always supported between Event Repositories.

X.4.2 Use Cases

The SOLE event report content is motivated by the reports and informational displays that are to be generated from these reports. The starting point for these event definitions and selection is the work done by the SIIM Workflow initiative, see http://siim.org/?page=swim .

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[3] FHIR is the registered trademark of Health Level Seven International.

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

X.4.2.1 Use Case #1: Track Study Reading Activities

The following scenario shows a selection of events from a routine radiology reading activity that follows the IHE Radiology Scheduled Workflow Profile and reports events defined by SOLE. The actor that sends the event report is an Event Reporter grouped with the actor shown in the

345 diagram. The diagrams are split between acquisition and preparation in the first diagram, and reporting in the second diagram.

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.

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

Figure X.4.2.1-1: Event reporting during image acquisition phase

355

The text in Figure X.4.2.1-2 was used to generate the diagram in Figure X.4.2.1-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

360

```
Order-perform-study.txt

@startuml
participant "Event Repository"

"Order Placer" -> "Event Repository" : "ITI-20: (Exam Ordered)"
"Order Filler" -> "Event Repository" : "ITI-20: (AppoinntmentTimeScheduled)"
"ADT" --> "Event Repository" : "ITI-20 (PatientArrivedAtImaging)"
"Patient Location\nTracking Supplier" --> "Event Repository" : "ITI-20: (PatientIn)"
"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)"
"Image Manager/Archive" --> "Event Repository" : "ITI-20: (StudyPrepared)"

@enduml
```

365

370

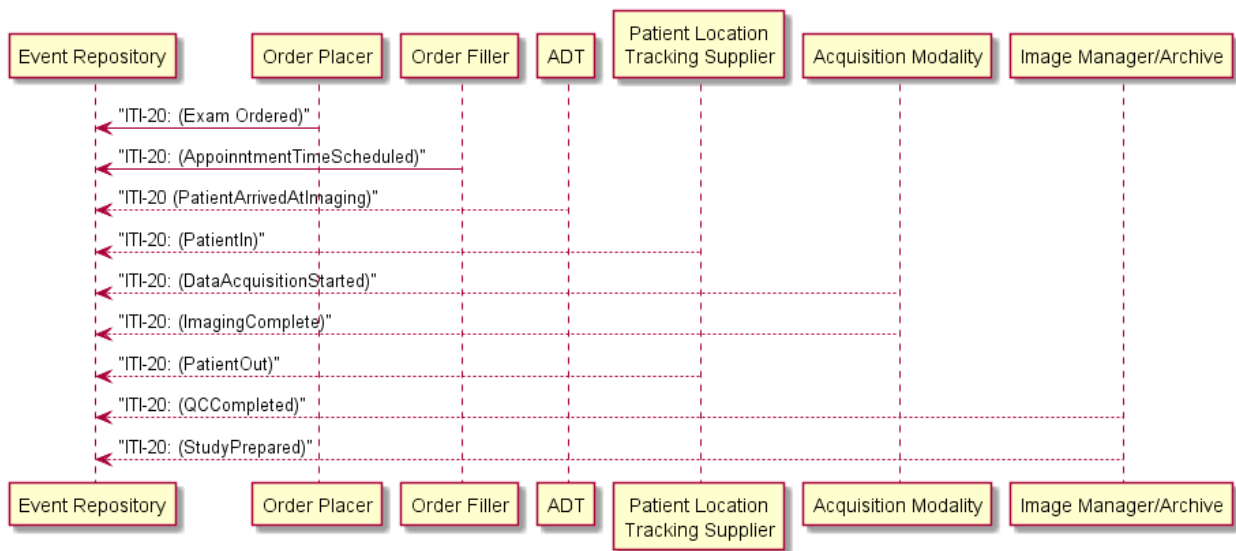375   **Figure X.4.2.1-2: Pseudocode for Event reporting during image acquisition phase**
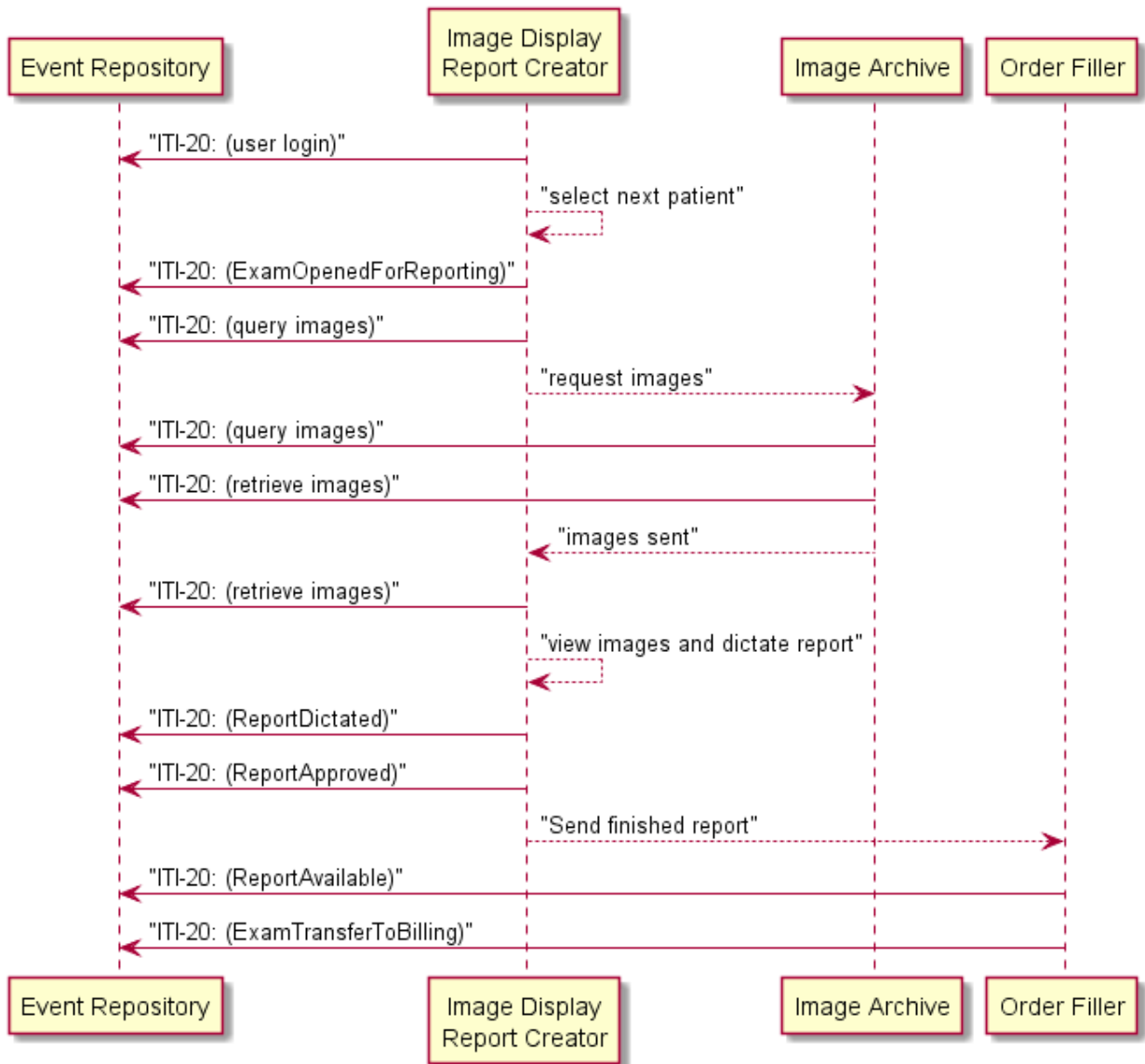
Figure X.4.2.1-3: Event reporting during exam reporting phase

380

The text in Figure X.4.2.1-4 was used to generate the diagram in Figure X.4.2.1-3. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

385

```
Routine-report.txt

@startuml

participant "Event Repository"
390   participant "Image Display\nReport Creator" as Display

Display -> "Event Repository" : "ITI-20: (user login - ATNA)"
Display --> Display : "select next patient"
Display -> "Event Repository" : "ITI-20: (ExamOpenedForReporting)"
395   Display -> "Event Repository" : "ITI-20: (query images)"
Display -> "Image Archive" : "Query Images [RAD-14]"
"Image Archive" -> "Event Repository" : "ITI-20: (query images)"
"Image Archive" -> "Event Repository" : "ITI-20: (retrieve images)"
"Image Archive" -> Display : "Retrieve Images [RAD-16]"
400   Display -> "Event Repository" : "ITI-20: (retrieve images)"
Display --> Display : "view images and dictate report"
Display -> "Event Repository" : "ITI-20: (ReportDictated)"
Display -> "Event Repository" : "ITI-20: (ReportApproved)"
Display --> "Order Filler" : "Send finished report"
405   "Order Filler" -> "Event Repository" : "ITI-20: (ReportAvailable)"
"Order Filler" -> "Event Repository" : "ITI-20: (ExamTransferToBilling)"

@enduml
```

Figure X.4.2.1-4: Pseudocode for Event reporting during exam reporting phase

410

X.4.2.2 Use Case #2: Analyze Events

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

415 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.

The analyst uses 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

420 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.
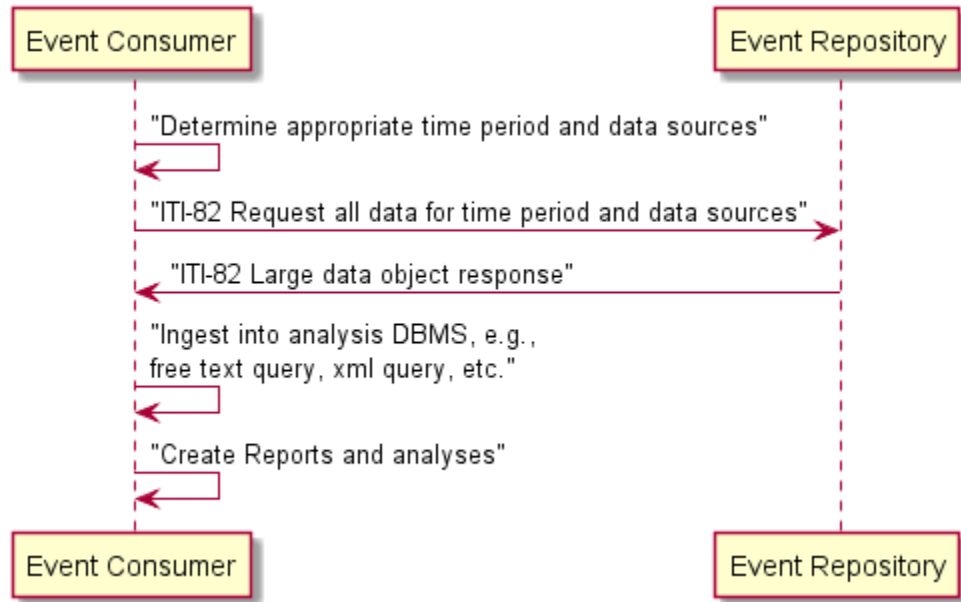
425   **Figure X.4.2.2-1: Imaging center activity analysis workflow**

The text in Figure X.4.2.2-2 was used to generate the diagram in Figure X.4.2.2-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

430
```
Syslog-query.txt

@startuml

"Event Consumer" -> "Event Consumer" : "Determine appropriate time period and data sources"
435  "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.,\nfree text query, xml
     query, etc."
440  "Event Consumer" -> "Event Consumer" : "Create Reports and analyses"

@enduml
```

Figure X.4.2.2-2: Pseudocode for Event reporting during image acquisition phase

445 **X.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

---

450   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.

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

455   optimized as designed by the device OS vendor.

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.

460   After successfully transferring the event reports to the Event Repository the mobile device cleans its internal log storage in preparation for future mobile activity.
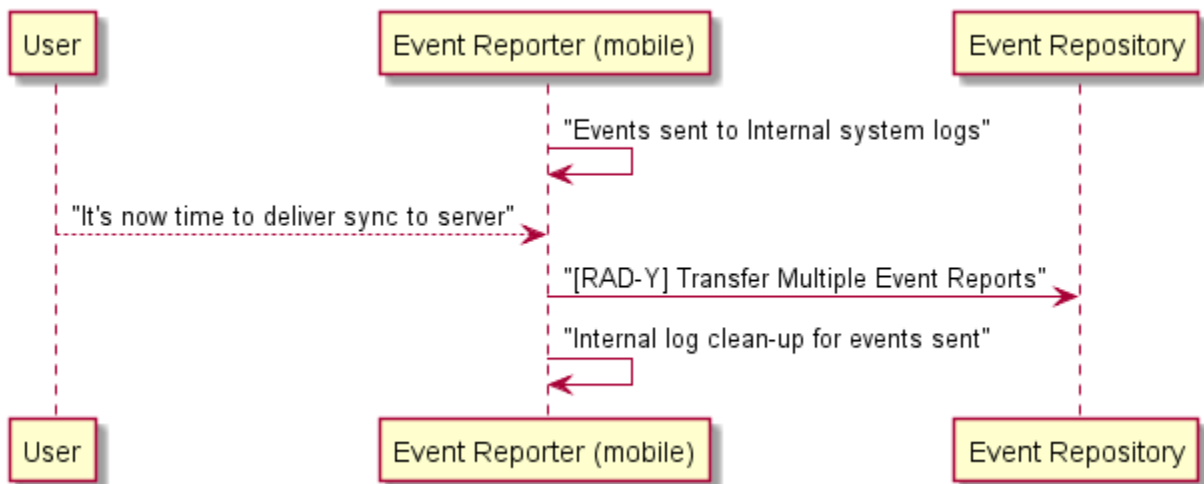
465   **Figure X.4.2.3-1: Event report transfer from mobile device**

The text in Figure X.4.2.3-2 was used to generate the diagram in Figure X.4.2.3-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

470

```
Mobile-push.txt

@startuml
actor 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-Y] Transfer Multiple Event Reports"
"Event Reporter (mobile)" -> "Event Reporter (mobile)" : "Internal log clean-up for events sent"

@enduml
```

475

480

Figure X.4.2.3-2: Pseudocode for Event reporting during image acquisition phase

X.4.2.4 Use Case #4: Dashboard

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

This dashboard receives SOLE event reports from the Event Repository as they are received by
490 the Event Repository. The Event Repository filters 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. The Event Repository filters are also configured and updated to reflect changes to the network. The Event Repository forwarding is configured and updated to reflect changes to the locations of the dashboards.

495 The dashboard system uses the SOLE event reports to maintain and update the internal status description used generate the visual graphics of the dashboard. The dashboard system has other administrative facilities to correct for network downtime, lost event reports, etc.
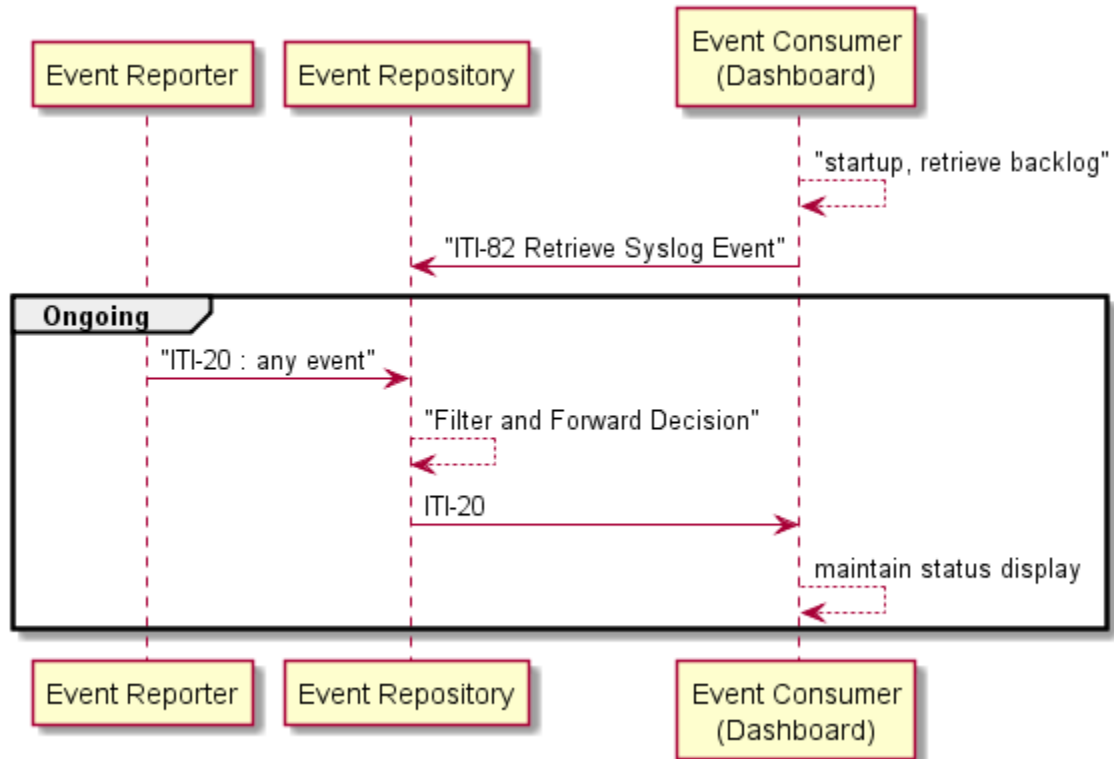
Figure X.4.2.4-1: Dashboard Event Flow

500

The text in Figure X.4.2.4-2 was used to generate the diagram in Figure X.4.2.4-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

505

510

515

520

```
pix-rest-workflow.txt

@startuml

participant "Event Reporter"
participant "Event Repository"
participant dashboard as "Event Consumer\n(Dashboard)"

dashboard --> dashboard : "startup, retrieve backlog"
dashboard -> "Event Repository" : "ITI-82 Retrieve Syslog Event"
group Ongoing
"Event Reporter" -> "Event Repository" : "ITI-20 (any event)"
"Event Repository" --> "Event Repository" : "Filter and Forward Decision"
"Event Repository" -> dashboard : "ITI-20 (Dashboard relevant event)"
dashboard --> dashboard : maintain status display
end

@enduml
```

Figure X.4.2.4-2: Pseudocode for Event reporting during image acquisition phase

X.4.2.5 Use Case #5: RESTful Delivery (outside analysis)

525 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.

The Event Repository has an administrative facility that allows it to perform a RESTful HTTP
530 PUT of the SOLE event reports from a specified time period. The operators of the Event Repository use the [RAD-Y] 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.
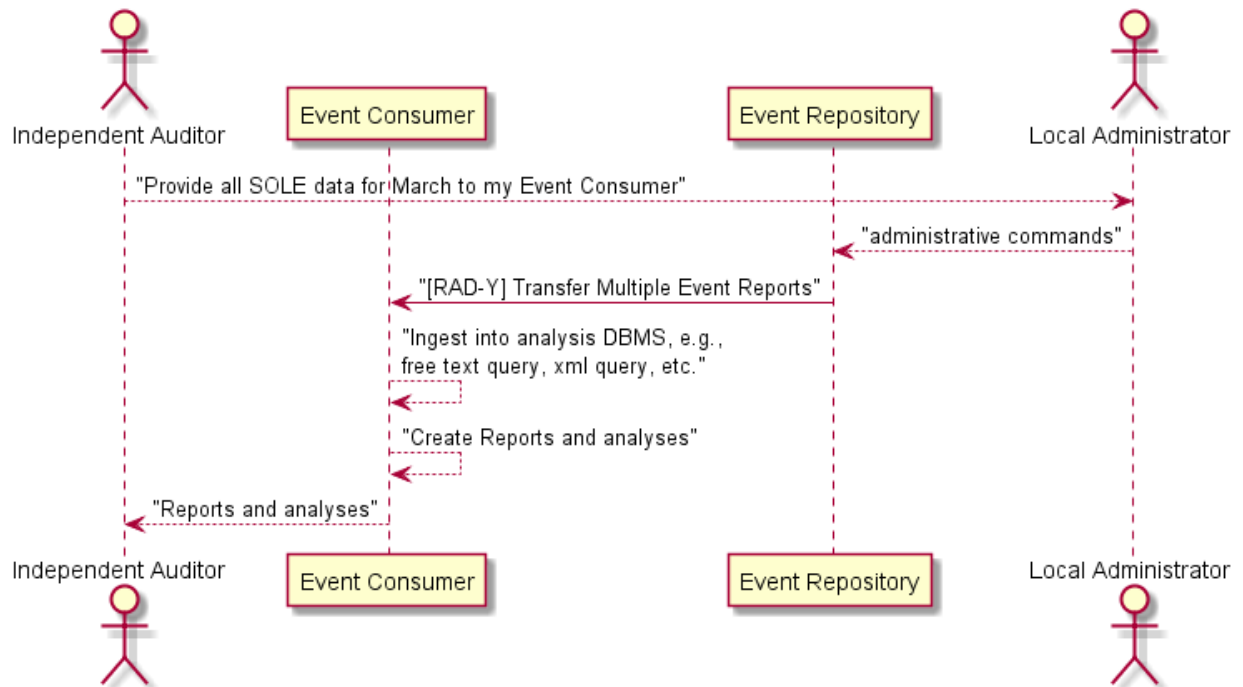
535

Figure X.4.2.5-1: Delivery of data for external analysis

540 The text in Figure X.4.2.5-2 was used to generate the diagram in Figure X.4.2.5-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
Analysis-push.txt

@startuml

actor "Independent Auditor"
participant "Event Consumer"
participant "Event Repository"
actor "Local Administrator"

"Independent Auditor" --> "Local Administrator" : "Provide all SOLE data for March to my Event
Consumer"
"Local Administrator" --> "Event Repository" : "administrative commands"
"Event Repository" -> "Event Consumer" : "[RAD-Y] Transfer Multiple Event Reports"
"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" : "Review reports and analyses"

@enduml
```

Figure X.4.2.5-2: Pseudocode for Event reporting during image acquisition phase

X.4.3 Contents of SOLE messages

The SOLE event report content is motivated by the reports and informational displays that are to be generated from these reports. The starting point for these event definitions and selection is the work done by the SIIM Workflow initiative, see http://siim.org/?page=swim .

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

X.5 SOLE Security Considerations

X.5.1 Security Considerations for Actors

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

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 a small 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.

X.5.2 Security Considerations for Event Reports

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 examination number, not the patient identification. The examination 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.

585   The patient ID is captured for admissions and discharges, and it can be associated with examinations. No effective way was found to remove this information from the event report, although a deployment might choose not to capture these events.

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

The personal work related information about staff, such as when they participated in a particular exam, 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.

X.6 SOLE Cross Profile Considerations

595   The Record Audit Event [ITI-20] transaction may be used 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 Repository is required to accept these SOLE event reports, but if it does not
600   claim the SOLE Profile it may discard them. If it supports both ATNA and SOLE Profiles, it will maintain all these event reports. A SOLE Event Repository is required to accept ATNA event reports, but if it does not claim the ATNA Profile it may discard them.

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

605   Other non-IHE activities and processes also use syslog events. A repository may receive and may process these.

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

Volume 3 – Transactions (cont.)

610 | *Add Section 4.Y*

4.Y Transfer Multiple Event Reports [RAD-Y]

Transfer Multiple Event Reports [RAD-Y] delivers syslog messages in bulk as a single RESTful transaction. The payload format is the same as for Retrieve Syslog Message [ITI-82].

4.Y.1 Scope

615 This transaction is used to provide a bulk transfer of event records, audit records, and other records in syslog format. It may be for transfer of bulk stored event records to a repository, transfer between repositories, or transfer to analysis systems.

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

620 ### 4.Y.2 Actor Roles

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

Table 4.Y.2-1: Actor Roles

Role:	Sender: Sends many event records

Actor(s):	The following actors may play the role of Sender:
	
	    Event Reporter:
	
	    Event Repository:

Role:	Receiver: Receives and processes many event records

Actor(s):	The following actors may play the role of Receiver:
	
	    Event Repository:
	
	    Event Consumer:

625 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.

4.Y.3 Referenced Standards

[RFC 1945]　　IETF. May 1996. Hypertext Transfer Protocol Version 1.0 (HTTP/1.0). http://tools.ietf.org/html/rfc1945.

630　[RFC 2818]　　IETF. May 2000. HTTP Over TLS. http://tools.ietf.org/html/rfc2818.

[RFC 5234]　　IETF. January 2008. Augmented BNF for Syntax Specifications: ABNF. http://tools.ietf.org/html/rfc5234

[RFC 7230]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Message Syntax and Routing. http://tools.ietf.org/html/rfc7230.

635　[RFC 7231]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Semantics and Content. http://tools.ietf.org/html/rfc7231.

[RFC 7232]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Conditional Requests. http://tools.ietf.org/html/rfc7232.

[RFC 7233]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Range Requests.
640　http://tools.ietf.org/html/rfc7233.

[RFC 7234]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Caching. http://tools.ietf.org/html/rfc7234.

[RFC 7235]　　IETF. June 2014. Hypertext Transfer Protocol (HTTP/1.1): Authentication. http://tools.ietf.org/html/rfc7235.

645　[RFC 7236]　　IETF. June 2014. Initial Hypertext Transfer Protocol (HTTP) Authentication Scheme Registrations. http://tools.ietf.org/ html/rfc7236.

[RFC 7237]　　IETF. June 2014. Initial Hypertext Transfer Protocol (HTTP) Method Registrations. http://tools.ietf.org/html/rfc7237.

[RFC 7540]　　IETF. May 2015. Hypertext Transfer Protocol Version 2 (HTTP/2).
650　http://tools.ietf.org/html/rfc7540.

4.Y.4 Interaction Diagram
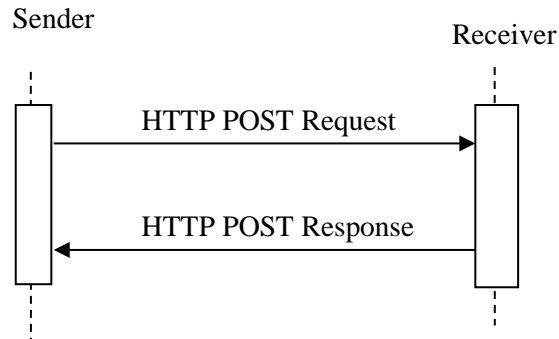
Figure 4.Y.4-1: Interaction Diagram

655 ## 4.Y.4.1 HTTP POST Request

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

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

4.Y.4.1.1 Trigger Events

660 The Sender initiates this transaction whenever it determines that it has a sufficient collection of syslog reports. For example, a mobile device that uses an internal proprietary event log while operating offline could initiate this transaction when it returns to a home location with good power and network connections.

4.Y.4.1.2 Message Semantics

665 The message is an HTTP POST request. The Sender is the user-agent. The Receiver is the origin-server. The request syntax is:

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

4.Y.4.1.2.1 Resource

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

675 **4.Y.4.1.2.2 Query Parameters**

There are no Query Parameters.

4.Y.4.1.2.3 Request Header Fields

Table 4.Y.4.1.2.3-1: Request Header Fields

Header Field	Value	Requirements
Content-Type	application/json	Required
Accept	application/json	Required
Content-Length	uint	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	Shall be present if a transfer coding has been applied. Shall be absent otherwise.

680

4.Y.4.1.2.4 Request Payload

The request payload shall be present and shall contain all the JSON encoded bulk event records.

The syslog messages shall be encoded as described in ITI TF-2c: Table 3.82.4.2.2-1. See the ITI "Add RESTful Query to ATNA" Trial Implementation Supplement.

685 **4.Y.4.1.2.4.1 Example JSON encoding**

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

```
        "Pri": "101",
710     "Version": "1",
        "Timestamp": "2015-03-17T00:15"
        "Hostname": "nemo.frodo.org"
        "App-name": "su"
        "Procid": "1234"
715     "Msg-id": "su-stop"
        "Msg": "su root completed for gandalf"
        }
{
        "Pri": "101",
720     "version": "1",
        "Timestamp": "2015-03-17T00:15"
        "Hostname": "nemo.frodo.org"
        "App-name": "IHE+SOLE"
        "Procid": "1234"
725     "Msg-id": "RID45813"
        "Msg": "<?xml version="1.0" encoding="UTF-8"?>
<AuditMessage>

    <EventIdentification EventDateTime="2016-10-17T15:12:04.287-06:00"
730     EventOutcomeIndicator="0"
        EventActionCode="E">
        <EventID csd-code="SOLE" codeSystemName="IHE-RAD"
originalText="Imaging Operational Event" />
        <EventTypeCode csd-code="RID45813" codeSystemName="RadLex"
735 originalText="Order Entered" />
    </EventIdentification>

    <ActiveParticipant UserID="EmpID12345678"
        UserIsRequestor="true">
740     <RoleIDCode csd-code="121096" codeSystemName="DCM"
originalText="Ordering Physician" />
        <Shift 3 />
        <Department Emergency />
    </ActiveParticipant>
745
    <ActiveParticipant UserID="EMR7"
        UserIsRequestor="false"
        NetworkAccessPointTypeCode="1"
        NetworkAccessPointID="125.20.175.12">
750     <RoleIDCode csd-code="110150" codeSystemName="DCM"
originalText="Application" />
<RoleIDCode csd-code="New07" codeSystemName="IHE-SOLE"
originalText="Automated Order Machine" />
    </ActiveParticipant>
755
    <AuditSourceIdentification code="1"
        AuditEnterpriseSiteID="End User"
AuditSourceID="farley.granger@wb.com"/>

760     <ParticipantObjectIdentification
```

```
            ParticipantObjectTypeCodeRole="4">
            <ParticipantObjectIDTypeCode csd-code="363679005"
codeSystemName="SNOMED-CT" originalText="Imaging Procedure - Exam" />
            <ParticipantObjectID 12345678654321 />
765      </ParticipantObjectIdentification>

       <ParticipantObjectIdentification
          ParticipantObjectTypeCodeRole="4">
            <ParticipantObjectIDTypeCode csd-code="363679005121022"
770   codeSystemName="DCM" originalText="Accession Number" />
            <ParticipantObjectID 12345678901234 />
         </ParticipantObjectIdentification>


      </AuditMessage>"
775  }
     ]
     }
```

4.Y.4.1.3 Expected Actions

780 The Receiver saves the events contained in the request payload and returns a response. The Receiver may perform other processing that is specified in a profile's actor requirements.

4.Y.4.2 HTTP Post Response

4.Y.4.2.1 Trigger Events

Receiver receives an HTTP Post Request.

785 **4.Y.4.2.2 Message Semantics**

The message is an HTTP Post Response. The Sender is the user-agent. The Receiver is the origin-server.

The response shall have the following syntax:
```
     version SP status-code SP reason-phrase CRLF
790  *(header-field CRLF)
     CRLF
     [Status Report]
```

4.Y.4.2.2.1 Status Codes

The response shall have an appropriate status code. Table 4.Y.4.2.2.1-1 contains the most
795 common status codes for this transaction. Any status code defined for HTTP transactions may be used.

Table 4.Y.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].
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.

4.Y.4.2.2.2 Response Header Fields

800

Table 4.Y.4.2.2.2-1: Response Header Fields

Header Field	Value	Requirements
Content-Type	application/json	Required
Content-Length	uint	Shall be present if no transfer coding has been applied. Shall be absent otherwise.
Transfer-Encoding	encoding	Shall be present if a transfer coding has been applied. Shall be absent otherwise.

4.Y.4.2.2.3 Response Payload

If the Receiver failed to store or modified any representations in the request payload, the
805 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.

4.Y.4.2.3 Expected Actions

In the event of any of the success family of status codes, 20x, the Sender can proceed. There is
810 no transaction specific behavior for a success. The Sender may process a Status Report if present. This may enable recovery from error responses.

4.Y.5 Security Considerations

The event reports may contain patient information, and transport protection may be necessary. The Syslog transport includes both UDP and TLS mappings. The TLS selection may be appropriate for this reason.

The event reports are often important for detection of security flaws, so authentication protections such as TLS may be appropriate to protect the endpoints from attack. The event repository and analysis systems are often an important part of detection of security flows. These systems may need special consideration and protection because they are a primary target for malicious attackers.

A risk analysis that considers the information that will be carried and the network topology should be the basis for determining whether the TLS alternative should be deployed for transport, and what special protections are appropriate. Grouping with an ATNA Secure Node or Secure Application is often appropriate, and may be required by a specific profile.

4.Y.5.1 Security Audit Considerations

There are no special audit considerations.

Volume 3 – Content Modules

5 Namespaces and Vocabularies

830 | *Add to Section 5 Namespaces and Vocabularies*

The following codes are suggested for addition to the RADLex codes for SWIM. They are shown as IHE-RAD codes, but will be suggested to RADLex.

codeSystem	codeSystemName	Description
IHE-RAD	RID???1	Exam Ordered The exam order is entered into the order placer system
IHE-RAD	RID???2	Patient Arrived at Imaging The patient checks-in at modality waiting area for the exams
IHE-RAD	RID???3	ResourceAssigned A resource, e.g., a specific imaging machine, device or imaging specialist, is assigned to a procedure.
IHE-RAD	RID???5	QC Repeat Ordered QC rejected images, Reject/repeat ordered.
IHE-RAD	RID???6	Crit 2 Notification Closed A category 2 (hours) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group http://dx.doi.org/10.1016/j.jacr.2013.12.016) is communicated to a physician taking care of patient.
IHE-RAD	RID???7	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 http://dx.doi.org/10.1016/j.jacr.2013.12.016) is delegated.
IHE-RAD	RID???9	Exam Cancelled The exam is cancelled after acquisition, but before during or after reporting.
IHE-RAD	RID???10	Exam Exception Detected The exam has an exception condition that must be administratively resolved.
IHE-RAD	RID???11	Exam Exception Resolved The exam exception condition has been administratively resolved.

835

The following codes need to be assigned by IHE

codeSystem	codeSystemName	Description
IHE-RAD	IHE???1	Appointment Resource The resource is an appointment identification.
IHE-RAD	IHE???2	Location of Event This is the location at which an event has taken place.
IHE-RAD	IHE???3	Location Assigned The location for which an event has been assigned or planned.
IHE-RAD	New01	Physician sending notification
IHE-RAD	New02	Physician accepting notification
IHE-RAD	New03	Human Scheduler
IHE-RAD	New04	Admitting Staff
IHE-RAD	New05	Transport A person responsible for transporting patients.
IHE-RAD	New06	Order placer A system that accepts and manages orders
IHE-RAD	New07	Order filler A system that manages order fulfilment
IHE-RAD	New08	Automatic Scheduler
IHE-RAD	New09	Automatic Admitting System
IHE-RAD	New10	Imaging Modality (generic) Any machine that performs imaging acquisition
IHE-RAD	New11	EMR A system that manages electronic medical records for an organization.
IHE-RAD	New12	PACS A system that manages images and associated data for an organization.
IHE-RAD	New13	RIS A system that manages information flow and operations for an imaging department.
IHE-RAD	New14	Imaging Workstation A system used for viewing images and related functions such as reporting.
IHE-RAD	New15	Image Archive A system used for archival storage of images and associated data.

6 Content Modules

840 ## 6.X SOLE Event Definitions

The events described in SWIM http://siim.org/resource/resmgr/swim/SWIMRadlex1.xlsx are reported as SOLE event reports. The semantic content to be included in the report is defined in event semantics, and the encoding of those semantics defined in event report encoding.

6.X.1 SWIM and SOLE Event selection

845 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
850 lexicon. Finally, events that are considered highly valuable based on current business intelligence systems were also identified and included in the list.

6.X.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
855 with other events from the RADLEX SWIM list, or by locally defined events.

Table 6.X.2-1: Baseline SOLE Events

Name and Event Code	Definition: "The time when:"	Active Participants	Passive Participants
Exam Ordered RID???1	The exam order is entered into the order placer system	Automated order management (0..1) [Machine] Ordering Physician (0..1)[Person]	Exam(1..1)[Object] Accession Number(0..1)[Object]
Order Entered RID45813	The physician ordered exams	Automated order management (0..1) [Machine] Ordering Physician (0..1) [Person]	Order number (1..1) [Object] Exam(1..n) [Object]
AppointmentTimeScheduled RID45814	The scheduler set the Appointment Time for the exam	Human Scheduler (0..1) [Person] Automated scheduler (0..1) [Machine] At least one shall be present	Exam(1..1)[Object]
PatientArrivedat Imaging (RID???2)	The patient checks-in at modality waiting area for the exams	Admitting Staff(0..1) [Person] Automatic Check In System (0..1) [Machine]	Patient (1..1)[Patient] Arrival Location(0..1)[Location]

Name and Event Code	Definition: "The time when:"	Active Participants	Passive Participants
PatientArrived 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(0..1)[Location]
RoomAssigned RID45934	The room is assigned to a procedure	Human Scheduler (0..1) [Person] Automated scheduler (0..1) [Machine] At least one shall be present	Exam(1..1)[Object] Room Location(0..1)[Location]
ResourceAssigned RID???3	A resource, e.g., a specific imaging machine, device or imaging specialist, is assigned to a procedure.	Human Scheduler (0..1) [Person] Automated scheduler (0..1) [Machine] At least one shall be present	Exam(1..1)[Object] Resource (0..1)[Resource]
PatientIn RID45897	the patient enters the procedure room	Transport (0..1)[Person]	Exam(1..1)[Object] Room Location(0..1)[Location]
PatientOut RID45899	the patient leaves the procedure room	Transport (0..1)[Person]	Exam(1..1)[Object] Room Location(0..1)[Location]
DataAcquisition Started RID46000	the imaging device begins to collect data	Imaging Modality (1..1)[Machine] Technologist(0..1)[Person]	Exam(1..1)[Object]
ImagingComplete RID45835	All images are acquired and reconstructed (including routine additional reconstructions/reformations done on the imaging device) on the imaging device.	Imaging Modality (1..1)[Machine] Technologist(0..1)[Person]	Exam(1..1)[Object]
StudyPrepared RID45914	All steps required for reporting completed (images acquired, transmitted to reporting device, post-processing done) e.g., Exam put onto reading or QC worklist.	Technologist(0..1)[Person]	Exam(1..1)[Object]
QCCompleted RID28816	Delete unacceptable images, adjust W/L, confirm correct patient, etc. Typically done by a technologist	Technologist(0..1)[Person]	Exam(1..1)[Object]
QC Reject RID28816	QC rejects images, Typically done by a technologist	Technologist(0..1)[Person]	Exam(1..1)[Object]
QC Repeat Ordered RID???5	QC rejected images, Reject/repeat ordered.	Technologist(0..1)[Person]	Exam(1..1)[Object]

Name and Event Code	Definition: "The time when:"	Active Participants	Passive Participants
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 http://dx.doi.org/10.1016/j.jacr.2013.12.016) is communicated to a physician taking care of patient.	Physician(2..2)[Person]	Exam(1..1)[Object]
Crit 2 Notification Closed RID???6	A category 2 (hours) finding (ACR definition, see Actionable Findings and the Role of IT Support: Report of the ACR Actionable Reporting Work Group http://dx.doi.org/10.1016/j.jacr.2013.12.016) is communicated to a physician taking care of patient.	Physician(2..2)[Person]	Exam(1..1)[Object]
Crit 3 Notification Delegated RID???7	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 http://dx.doi.org/10.1016/j.jacr.2013.12.016) is delegated.	Physician(1..2)[Person]	Exam(1..1)[Object]
ReportDictated RID45859	Physician reviews image and renders a report in electronic audio format	Physician(1..1)[Person]	Exam(1..1)[Object]
ReportApproved RID45924	Final text form report is approved(signed)	Physician(1..1)[Person]	Exam(1..1)[Object]
ReportAvailable RID45850	Final report and exam is available to ordering physician	EMR/PACS/RIS(1..n)[Machine]	Exam(1..1)[Object]
ReportSent RID45865	Final report and exam is sent to ordering physician (EMR confirmation of receipt)	EMR/PACS/RIS(1..n)[Machine]	Exam(1..1)[Object]
ExamArchiveCommit RID4580	Exam is transferred to an external archive or VNA	Image Archive(1..1)[Machine]	Exam(1..1)[Object]
ExamTransferToBilling RID45836	Complete billing information on exam has been transferred to billing system	EMR (1..1)[Machine]	Exam(1..1)[Object]
PatientMerged RID45898	Exams of a patient with 2 IDs are merged to 1 of the IDs	PACS/RIS/EMR (1..1)[Machine]	Exam(1..n) [Object] Patient (2..n)[Patient]

Name and Event Code	Definition: "The time when:"	Active Participants	Passive Participants
ExamReassigned RID45863	Change the patient ID for an exam to a different patient ID (e.g., trauma patient ID reconciliation)	PACS/RIS/EMR (1..1)[Machine]	Exam(1..n) [Object] Patient (2..n)[Patient]
ExamRemoved RID45856	The exam and any associated images are deleted (or made unavailable)	PACS/RIS/EMR (1..1)[Machine]	Exam(1..1) [Object]
ExamOpenedFor Reporting RID45893	The exam is opened on viewing application by the radiologist for reporting	PACS/RIS/EMR/Imaging Workstation (1..1)[Machine]	Exam(1..1)[Object]
ExamCancelled RID45862	The exam is cancelled either before or during the acquisition. See Note 1.	PACS/RIS/EMR/Workstation (1..1)[Machine]	Exam(1..1)[Object]
ExamCancelled RID???9	The exam is cancelled after acquisition, but before during or after reporting. See Note 1.	PACS/RIS/EMR/Workstation (1..1)[Machine]	Exam(1..1)[Object]
ExamException Detected RID???10	The exam has an exception condition that must be administratively resolved. See Note 1.	PACS/RIS/EMR/Workstation (1..1)[Machine]	Exam(1..1)[Object]
ExamException Resolved RID???11	The exam exception condition has been administratively resolved.	PACS/RIS/EMR/Workstation (1..1)[Machine]	Exam(1..1)[Object]
Exam Prefetch Completed RID45907	When the prefetch images are completed and transferred to PACS. Automated retrieval of relevant priors (e.g., prefetch) is completed for the current exam.	PACS/RIS/Image Archive(1..1)[Machine]	Exam(1..1)[Object]

6.X.3 Event Reports.

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

6.X.3.1 Encoding an event Report

Event reports shall be encoded in accordance with the schema in DICOM PS3.15 Section A.5. The tables below define the encoding of the event and the participants. In Table 6.X.2-1, each
865 participant indicates which of the participant tables below describes the participant.

870

Table 6.X.3.1-1: Event Report Fields

	Field Name	Opt	Value Constraints
Event **AuditMessage/** **EventIdentification**	EventID	M	**EV(SOLE, IHE, "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.X.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.X.3.1-2: Audit Source Encoding

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

875

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

Table 6.X.3.1-2: Machine Participant Encoding

Machine Participant **AuditMessage/** **ActiveParticipant**	Field Name	Opt	Value Constraints
	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.
	UserName	*U*	*not specialized (DICOM PS3.15 Section A.5)*
	RoleIDCode	M	***See Section 6.x.5.2***
	NetworkAccessPointTypeCode	M	"1" for machine name, "2" for IP address
	NetworkAccessPointID	M	The machine name (in DNS) or IP address.

880

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

Table 6.X.3.1-3: Person Participant Fields

Person Participant AuditMessage/ ActiveParticipant	Field Name	Opt	Value Constraints
	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).
	UserName	*U*	*not specialized (DICOM PS3.15 Section A.5)*
	UserIsRequestor	*U*	*not specialized (DICOM PS3.15 Section A.5)*
	RoleIDCode	M	**See Section 6.x.5.1**
	Department	U	See Section 6.x.5.5 Departments
	Shift	U	See Section 6.x.5.6 Shift

885 **Object Participants** are software and conceptual objects, e.g., "exam" and "report".

Table 6.X.3.1-4: Object Participant Encoding

Object Participant (AuditMessage/ ParticipantObject)	Field Name	Opt	Value Constraints
	ParticipantObjectTypeCode	M	"2" (system object)
	ParticipantObjectTypeCodeRole	M	**See Section 6.x.5.3, participating object roles**
	ParticipantObjectID	*M*	*not specialized (DICOM PS3.15 Section A.5)*
	ParticipantObjectIDTypeCode	*M*	*not specialized (DICOM PS3.15 Section A.5)*

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

890

Table 6.X.3.1-5: Resource Participant Encoding

Resource Participant (AuditMessage/ ParticipantObject)	Field Name	Opt	Value Constraints
	ParticipantObjectTypeCode	M	"2" (system object)
	ParticipantObjectTypeCodeRole	M	**See Section 6.x.5.3, participating object roles**
	ParticipantObjectID	*M*	*not specialized (DICOM PS3.15 Section A.5)*
	ParticipantObjectIDTypeCode	*M*	*not specialized (DICOM PS3.15 Section A.5)*

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
895 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. Marys of Boston Clinic Rooms", and the name for the location within that encoding shall be specified, e.g., "Grant CT Suite A".

900

Table 6.X.3.1-6: Location Participant Encoding

Location Participant (AuditMessage/ ParticipantObject)	**Field Name**	**Opt**	**Value Constraints**
	ParticipantObjectTypeCode	M	"2" (system object)
	ParticipantObjectTypeCodeRole	M	**EV(IHE???2,IHE,"Location of Event")** or **EV(IHE??3, IHE, "Location assigned")**
	ParticipantObjectID	*M*	*not specialized (DICOM PS3.15 Section A.5)*
	ParticipantObjectIDTypeCode	*M*	*not specialized (DICOM PS3.15 Section A.5)*
	ParticipantObjectDetail	M	"Location"=<location-value-string> "Location-encoding"=<name-for-location-encoding>

Patient participants are the patients.

Table 6.X.3.1-7: Patient Participant Encoding

Patient Participant (AuditMessage/ ParticipantObject)	**Field Name**	**Opt**	**Value Constraints**
	ParticipantObjectTypeCode	M	"1" (person)
	ParticipantObjectTypeCodeRole	M	**EV(121025,DCM,"Patient")**
	ParticipantObjectSensitivity	*U*	*not specialized (DICOM PS3.15 Section A.5)*
	ParticipantObjectID	M	the human ID in HL7[4] CX format.
	ParticipantObjectIDTypeCode	*M*	*not specialized (DICOM PS3.15 Section A.5)*

905

6.X.4 Coded Terminologies

6.X.4.1 Person participant roles

When a person is described as a person participant in an event report, their role describes the activity that they performed. This is different than an organizational role. A surgeon that refers a
910 patient for an exam would have an organizational role of surgeon and a participant role of referring physician.

6.X.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
915 message. It is reproduced here for convenience.

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[4] HL7 is the registered trademark of Health Level Seven International.

Table 6.X.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
Include CID 7451 "Family Member" *http://dicom.nema.org/medical/dicom/current/output/chtml/part16/sect_CID_7451.html*				
Include CID 7452 "Organizational Roles" *http://dicom.nema.org/medical/dicom/current/output/chtml/part16/sect_CID_7452.html*				

920

6.X.4.1.2 Additional Roles

The following additional roles may be used in SOLE messages.

Table 6.X.4.1.2-1: Additional Roles for SOLE Messages

Coding Scheme Designator	Code Value	Code Meaning	Definition
DCM	121096	Ordering Physician	
IHE-RAD	*New01*	Physician sending notification	
IHE-RAD	*New02*	Physician accepting notification	
IHE-RAD	*New03*	Human Scheduler	
IHE-RAD	*New04*	Admitting Staff	
IHE-RAD	*New05*	Transport Staff	

925

6.X.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.

930

Table 6.X.4.2-1: Device Participating Roles

Coding Scheme Designator	Code Value	Code Meaning	Definition
DCM	113859	Irradiating Device	
DCM	121097	Recording	
DCM	113942	X-Ray Reading Device	
IHE-RAD	*New*07	Automatic Order Management	
IHE-RAD	*New*08	Automatic Scheduler	
IHE-RAD	*New*09	Automatic Admitting System	
IHE-RAD	*New*10	Modality (generic)	
IHE-RAD	*New*11	EMR	
IHE-RAD	*New*12	PACS	
IHE-RAD	*New*13	RIS	
IHE-RAD	*New*14	Workstation	
IHE-RAD	*New*15	Archive	

6.X.4.3 Object Roles

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.

935

Table 6.X.4.3-1: Participating Object Roles

Coding Scheme Designator	Code Value	Code Meaning
IHE-RAD	IHE???1	Appointment
SNOMED	363679005	Imaging Procedure - Exam
SNOMED	371524004	Clinical Report
DCM	121022	Accession Number

6.X.4.4 Department

940 Department is an additional string element that is added to the AuditMessage/ParticipantObject. This string is optional. It can be used to convey a departmental location for a person when that person is participating in an event that is not in the usual location for that person. For example,

when a cardiologist that is normally in the Cardiology is involved in an event taking place in the Emergency Department, this element can be used to indicate the different location.

945 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.

6.X.4.5 Shift

Shift is an additional string element that is added to the AuditMessage/ParticipantObject. This string is optional. It can be used to convey a shift identifier for a person. This can be useful when 950 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.

6.X.5 Examples

```
        {
955     "Pri": "101",
        "version": "1",
        "Timestamp": "2015-03-17T00:15"
        "Hostname": "nemo.frodo.org"
        "App-name": "IHE+SOLE"
960     "Procid": "1234"
        "Msg-id": "RID45813"
        "Msg": "<?xml version="1.0" encoding="UTF-8"?>
<AuditMessage>

965   <EventIdentification EventDateTime="2016-10-17T15:12:04.287-06:00"
        EventOutcomeIndicator="0"
        EventActionCode="E">
        <EventID csd-code="SOLE" codeSystemName="IHE-RAD"
originalText="Imaging Operational Event" />
970     <EventTypeCode csd-code="RID45813" codeSystemName="RadLex"
originalText="Order Entered" />
    </EventIdentification>

    <ActiveParticipant UserID="EmpID12345678"
975     UserIsRequestor="true">
        <RoleIDCode csd-code="121096" codeSystemName="DCM"
originalText="Ordering Physician" />
        <Shift 3 />
        <Department Emergency />
980   </ActiveParticipant>

    <ActiveParticipant UserID="EMR7"
        UserIsRequestor="false"
        NetworkAccessPointTypeCode="1"
985     NetworkAccessPointID="125.20.175.12">
```

```
      <RoleIDCode csd-code="110150" codeSystemName="DCM"
originalText="Application" />
      <RoleIDCode csd-code="New07" codeSystemName="IHE-SOLE"
originalText="Automated Order Machine" />
   </ActiveParticipant>

   <AuditSourceIdentification code="1"
      AuditEnterpriseSiteID="End User"
AuditSourceID="farley.granger@wb.com"/>

   <ParticipantObjectIdentification
      ParticipantObjectTypeCodeRole="4">
      <ParticipantObjectIDTypeCode csd-code="363679005"
codeSystemName="SNOMED-CT" originalText="Imaging Procedure - Exam" />
      <ParticipantObjectID 12345678654321 />
   </ParticipantObjectIdentification>

   <ParticipantObjectIdentification
      ParticipantObjectTypeCodeRole="4">
      <ParticipantObjectIDTypeCode csd-code="363679005121022"
codeSystemName="DCM" originalText="Accession Number" />
      <ParticipantObjectID 12345678901234 />
   </ParticipantObjectIdentification>

   </AuditMessage>"
}
```

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