



Insignia Medical Systems Ltd DICOM Conformance Statement

ENTERPRISE PACS

BREAST PACS

DISASTER RECOVERY PACS

VNA

VERSION 2.3, REVISION 1: OCTOBER 2011

1 Conformance Statement Overview

The Insignia Enterprise PACS, Breast PACS, Disaster-Recovery PACS and Vendor-Neutral Archive (VNA) products share a common set of application components which constitute their DICOM interface to other systems. These components reside on the Insignia Departmental Server system component; hence this Conformance Statement is versioned in accordance with the Departmental Server. Each product also contains a central database and various short-term and long-term storage nodes with which the DICOM components interact. Each may also contain other system components, but these are not relevant to this document.

- The **Vendor-Neutral Archive** provides a self-contained system for archiving diagnostic medical images
- The **Disaster-Recovery PACS** provides a diagnostic medical image archive with full PACS functionality available at short notice in the event of an institution losing access to its primary PACS
- The **Breast PACS** provides a diagnostic medical image archive with fully integrated image viewing and reporting functionality and close integration with RIS and NBSS information systems, tailored to supporting Regional Breast Screening services
- The Insignia **Enterprise PACS** provides a diagnostic medical image archive with fully integrated image viewing and reporting functionality, and close integration with an institution’s RIS system.

In all four products, external digital imaging systems which also conform to the relevant sections of the DICOM standard can connect to the Insignia system to retrieve information about bookings (if the Insignia system receives an appropriate external information feed), submit images for permanent storage, retrieve information about those stored images and retrieve the images themselves.

The Insignia system may also connect to external systems to retrieve information about images that reside on those systems, and to request those images that it deems are required.

Table 1-1 shows the DICOM Network services provided and used by the Insignia components:

**Table 1-1
NETWORK SERVICES**

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Computed Radiography Image Storage	Yes	Yes
Digital X-Ray Image Storage – For Presentation	Yes	Yes
Digital X-Ray Image Storage – For Processing	Yes	Yes
Digital Mammography X-Ray Image Storage – For Presentation	Yes	Yes
Digital Mammography X-Ray Image Storage – For Processing	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	Yes	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	Yes	Yes
CT Image Storage	Yes	Yes
Enhanced CT Image Storage	Yes	Yes
Ultrasound Multi-frame Image Storage (Retired)	Yes	Yes
Ultrasound Multi-frame Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Enhanced MR Image Storage	Yes	Yes
MR Spectroscopy Storage	Yes	Yes
Enhanced MR Colour Image Storage	Yes	Yes

Nuclear Medicine Image Storage (Retired)	Yes	Yes
Ultrasound Image Storage (Retired)	Yes	Yes
Ultrasound Image Storage	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
Multi-frame Single Bit Secondary Capture Image Storage	Yes	Yes
Multi-frame Greyscale Byte Secondary Capture Image Storage	Yes	Yes
Multi-frame Greyscale Word Secondary Capture Image Storage	Yes	Yes
Multi-frame True Colour Secondary Capture Image Storage	Yes	Yes
Greyscale Softcopy Presentation State Storage	Yes	Yes
Colour Softcopy Presentation State Storage	Yes	Yes
Pseudo-Colour Softcopy Presentation State Storage	Yes	Yes
Blending Softcopy Presentation State Storage	Yes	Yes
XA/XRF Greyscale Softcopy Presentation State Storage	Yes	Yes
X-Ray Angiographic Image Storage	Yes	Yes
Enhanced XA Image Storage	Yes	Yes
X-Ray Radiofluoroscopic Image Storage	Yes	Yes
Enhanced XRF Image Storage	Yes	Yes
Nuclear Medicine Image Storage	Yes	Yes
Segmentation Storage	Yes	Yes
VL Endoscopic Image Storage	Yes	Yes
Video Endoscopic Image Storage	Yes	Yes
VL Microscopic Image Storage	Yes	Yes
Video Microscopic Image Storage	Yes	Yes
VL Slide-Coordinates Microscopic Image Storage	Yes	Yes
VL Photographic Image Storage	Yes	Yes
Video Photographic Image Storage	Yes	Yes
Ophthalmic Photography 8 Bit Image Storage	Yes	Yes
Ophthalmic Photography 16 Bit Image Storage	Yes	Yes
Basic Text SR	Yes	Yes
Enhanced SR	Yes	Yes
Comprehensive SR	Yes	Yes
Key Object Selection Document	Yes	Yes
Positron Emission Tomography Image Storage	Yes	Yes
RT Image Storage	Yes	Yes
Workflow Management		
Modality Worklist Information Model – FIND	No	Yes
Storage Commitment Push Model	No	Yes
Query/Retrieve		
Patient Root Query / Retrieve Information Model – FIND	Yes	Yes
Patient Root Query / Retrieve Information Model – MOVE	Yes	Yes
Study Root Query / Retrieve Information Model – FIND	Yes	Yes
Study Root Query / Retrieve Information Model – MOVE	Yes	Yes
Patient / Study Only Query/Retrieve Information Model – FIND (Retired)	Yes	Yes
Patient / Study Only Query/Retrieve Information Model – MOVE (Retired)	Yes	Yes

The Insignia Components described in this document do not support any DICOM Media Services.

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3 Introduction

3.1 Revision History

Document Version	Date	Author	Description
v2.3 r1	October 2011	Stephen Davis	Version for Departmental Server 2.3

3.2 Audience

This document is written for those who need to understand how the Insignia Enterprise PACS, Breast PACS, Disaster Recovery PACS or VNA will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, and integrators who need to have a detailed understanding of the DICOM features of the products.

This document contains some basic DICOM definitions so that any reader may understand how these products implement DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the products' functionality, and how that functionality integrates with other devices that support compatible DICOM features.

3.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between instances of the Insignia VNA and PACS product families and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability, however the Conformance Statement does facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement should not replace validation with other DICOM equipment to ensure proper exchange of intended information - the user should be aware of the following important issues:

- The comparison of different Conformance Statements is just the first step towards assessing interconnectivity and interoperability between these products and other DICOM conformant equipment
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility

3.4 Terms and Definitions

Informal definitions are provided for the following terms used in this Conformance Statement - the DICOM Standard is the authoritative source for formal definitions of these terms.

Abstract Syntax: the information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Modality Worklist Information Model Find SOP Class, Computed Radiography Image Storage SOP Class.

Application Entity (AE): an end point of a DICOM information exchange - i.e. the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title: the externally known name of an *Application Entity*, used to identify a DICOM application to other DICOM applications on the network.

Application Context: the specification of the type of communication used between *Application Entities*. For all DICOM communication this is the DICOM network protocol.

Association: a network communication channel set up between *Application Entities*.

Attribute: a unit of information in an object definition; a data element identified by a *tag*. The information may be a complex data structure (sequence), itself composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Photometric Interpretation (0028,0004), Procedure Code Sequence (0008,1032).

Information Object Definition (IOD): the set of *Attributes* that specify a class of data object. The *Attributes* may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3). There may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: MR Image IOD, CT Image IOD, Print Job IOD.

Module: a set of *Attributes* within an *Information Object Definition* that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.

Negotiation: first phase of *Association* establishment that allows *Application Entities* to agree on the types of data to be exchanged and how that data will be encoded.

Presentation Context: the set of DICOM network services used over an *Association*, as negotiated between *Application Entities*; includes *Abstract Syntaxes* and *Transfer Syntaxes*.

Protocol Data Unit (PDU): a packet of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

Presentation Data Value (PDV): a message fragment conveyed in a P-DATA *PDU*

Security Profile: a set of mechanisms, such as encryption, user authentication, or digital signatures, used by an *Application Entity* to ensure confidentiality, integrity, and/or availability of exchanged DICOM data.

Service Class Provider (SCP): role of an *Application Entity* that provides a DICOM network service; typically, a server that performs operations requested by another *Application Entity* (*Service Class User*).

Service Class User (SCU): role of an *Application Entity* that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU).

Service/Object Pair (SOP) Class: the specification of the network transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Ultrasound Image Storage Service, Basic Grayscale Print Management.

Service/Object Pair (SOP) Instance: an information object; a specific occurrence of information exchanged according to a *SOP Class* specification. Examples: a specific x-ray image.

Tag: a 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the “group” and the “element”. If the “group” number is odd, the tag is for a private (manufacturer-specific) data element. Examples: (0010,0020) [Patient ID], (07FE,0010) [Pixel Data], (0019,0210) [private data element].

Transfer Syntax: the encoding used for exchange of DICOM information objects and messages. Examples: JPEG compressed (images), little endian explicit value representation.

Unique Identifier (UID): a globally unique “dotted decimal” string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Value Representation (VR): the type of an individual DICOM data element, for example: text, integer, person name, code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or not (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to look up the format of each data element.

3.5 Basics of DICOM Communication

This section describes terminology used in this Conformance Statement for the non-specialist. The key terms used in the Conformance Statement are highlighted in *italics* below. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two *Application Entities* (devices) that want to communicate with each other over a network using the DICOM protocol must first agree on several things during an initial network “handshake” (*Negotiation*). One of the two devices must initiate an *Association* (a connection to the other device), and ask if specific services, information and encoding are supported by the other device.

DICOM specifies a number of network services and types of information objects, each of which is called an *Abstract Syntax* for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted *Transfer Syntaxes*. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called *Presentation Contexts*. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on *Roles* – which one is the *Service Class User* (SCU - client) and which is the *Service Class Provider* (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (*PDU*) size, security information, and network service options (called *Extended Negotiation* information).

The Application Entities, having negotiated the Association parameters, may now commence the exchange of data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports), and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate *Information Object Definition*, and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a *Response Status* indicating success, failure, or that query or retrieve operations are still in process.

3.6 Abbreviations

AE Application Entity
AET Application Entity Title
CR Computed Radiography
CT Computed Tomography
DICOM Digital Imaging and Communications in Medicine
DX Digital X-ray
GSDF Grayscale Standard Display Function
GSPS Grayscale Softcopy Presentation State
HL7 Health Level 7 Standard
IOD Information Object Definition
IPv4 Internet Protocol version 4
IPv6 Internet Protocol version 6
ISO International Organization for Standards
IO Intra-oral X-ray
JPEG Joint Photographic Experts Group
LUT Look-up Table
MG Mammography (X-ray)
MPPS Modality Performed Procedure Step
MR Magnetic Resonance Imaging
MSPS Modality Scheduled Procedure Step
MTU Maximum Transmission Unit (IP)
MWL Modality Worklist
NBSS National Breast Screening Service
NM Nuclear Medicine
O Optional (Key Attribute)
OP Ophthalmic Photography
OSI Open Systems Interconnection
PACS Picture Archiving and Communication System
PET Positron Emission Tomography
PDU Protocol Data Unit
R Required (Key Attribute)
RF Radiofluoroscopy
RIS Radiology Information System
RT Radiotherapy
SC Secondary Capture
SCP Service Class Provider
SCU Service Class User
SOP Service-Object Pair
SPS Scheduled Procedure Step
SR Structured Reporting
TCP/IP Transmission Control Protocol/Internet Protocol
U Unique (Key Attribute)
UL Upper Layer
US Ultrasound
VL Visible Light
VR Value Representation
XA X-ray Angiography

3.7 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>

4 Networking

4.1 Implementation Model

4.1.1 Application Data Flow

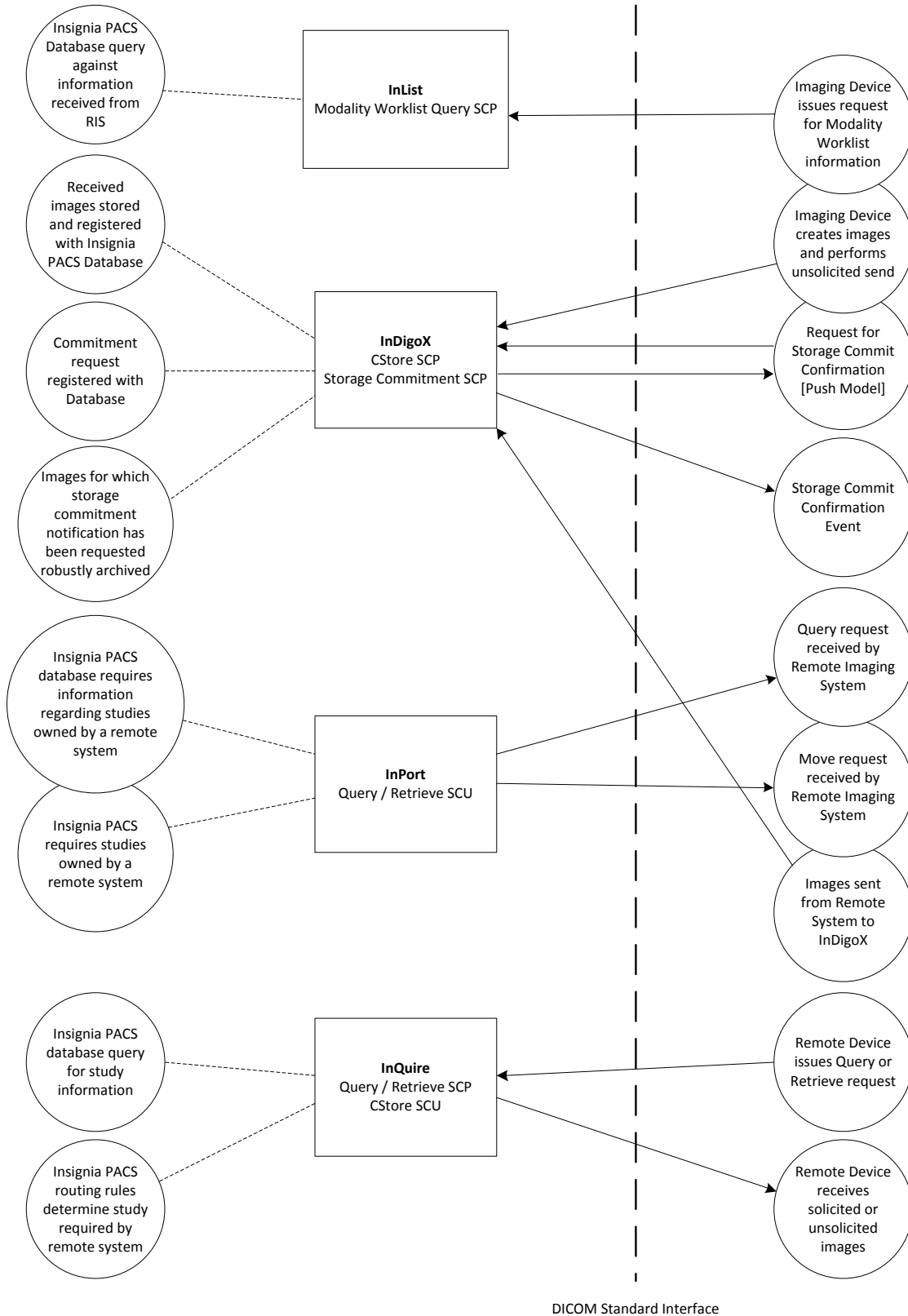


Figure 4.1-1 Insignia PACS DICOM Data Flow Diagram

Each Departmental Server node in the Insignia PACS has four distinct Application Entities, as shown in the Application Data Flow Diagram, **Figure 4.1-1**. These are Windows Services running on XP, Server 2003, 2008 or Windows 7, depending on the deployment of the Departmental Server in question. Each Application Entity has a unique AE Title within the PACS environment, and has a set of peer AE Titles from which and to which it will accept and request associations. Association requests from unknown AE Titles will be rejected.

- **InList** implements the Modality Worklist CFind service as an SCP. It handles an incoming Modality Worklist CFind request by performing a query against the Insignia Database for booking details received by the Insignia system from an institution's information system via an appropriate protocol such as HL7. If no such information feed exists, no results will be returned in the CFind response. InList will also respond to CEcho requests from known peer AEs.
- **InDigoX** implements the CStore service as an SCP for most common Storage SOP Classes. It also implements the Storage Commitment (Push Model) service as an SCP. When images are received they are written to local storage, and the details are registered with the Insignia database. When a Storage Commitment request is received, the SOP Instances requiring commit notification are noted in the database. When these SOP Instances are safely archived (the policy for this is determined by the institution, but is typically that the image exists on two separate long-term storage nodes in the system), InDigoX will notify the remote device that the commitment request has been fulfilled. InDigoX will also respond to CEcho requests from known peer AEs.
- **InPort** implements the Query / Retrieve services as an SCU. If the Insignia system wishes to interrogate a remote system for details of studies held for a certain patient, booking or date range, InPort will initiate a CFind request for the required data. If the Insignia system determines that some of those studies are required, InPort will issue CMove requests for those studies, with the C-Move Destination set to the InDigoX AE Title.
- **InQuire** implements the Query / Retrieve services as an SCP and the Storage service as an SCU. It handles Query requests for Patient, Study, Series and Instance information. When a Retrieve request is received, InQuire establishes a CStore association with the specified C-Move Destination AE and sends the SOP Instances itself. The Insignia PACS products also have routing rules and user interactions that may result in InQuire sending unsolicited SOP Instances to a remote AE. InQuire will also respond to CEcho requests from known peer AEs.

4.1.2 Functional Definition of AEs

4.1.2.1 Functional Definition of InList

InList waits for another DICOM application to connect on the network socket configured for its Application Entity Title. It will accept Associations with Presentation Contexts for the DICOM Modality Worklist CFind Service Class and Verification Service Class. If the Insignia system receives a suitable HL7 or other data feed from an external information system such as an Institution's RIS or NBSS the response to a Modality Worklist query request will be generated from booking information held by the Insignia Database.

4.1.2.2 Functional Definition of InDigoX

InDigoX waits for another DICOM application to connect on the network socket configured for its Application Entity Title. It will accept Associations with Presentation Contexts for SOP Classes of the Verification, Storage, and Storage Commitment (Push Model) Service Classes. Any images received on such Presentation Contexts will be written to Local Storage and registered with the Insignia database. These

images are then queued by the Insignia system for copying to long-term storage nodes. Once robustly archived (the semantics of which depend on the Institution, but typically constitute an image being on two long-term storage nodes), an image becomes a candidate for deletion from the Local Storage node as and when space is required for newly acquired images. The local storage node will typically have space for between six months and several years' worth of images, depending on the product's deployment details, and a SOP Instance can be expected to remain on local storage for this length of time.

If a Storage Commitment Push Model N-ACTION Request is received for images that reside on the Local Storage node, InDigoX will immediately check whether the referenced Composite SOP Instances are robustly archived by the Insignia system. If so, InDigoX will attempt to send the N-EVENT-REPORT notification over the existing association. If the SOP Instances are not already robustly archived, or the association has already been released, InDigoX will poll the Insignia database once a minute for completed Storage Commitment requests. When a request is complete, InDigoX will open a new association to the peer as the Storage Commitment SCP and send the N-EVENT-REPORT notification.

4.1.2.3 Functional Definition of InPort

InPort will instigate a Query association with a remote DICOM Application Entity when triggered to do so by user interaction or automated rules within the Insignia system. The Query will be for the details of all studies for a given patient, for the studies related to a specific booking, or for studies within a specific date or time range. Once the study details have been retrieved, the Insignia system will determine which studies are required, and InPort will initiate a Retrieve association with the remote DICOM Application Entity that was specified as the Retrieve AE in the query results for each given study. InPort will specify the InDigoX Application Entity Title as the C-Move Destination AE.

4.1.2.4 Functional Definition of InQuire

InQuire waits for another DICOM application to connect on the network socket configured for its Application Entity Title. InQuire will accept Associations with Presentation Contexts for SOP Classes of the DICOM Query-Retrieve Service Class and Verification Service Class. It will handle query and retrieve requests on these Presentation Contexts and respond with data objects with values corresponding to the contents of the Insignia Database. For C-MOVE requests the destination for the image objects is determined from the Destination AE Title contained in the C-MOVE request. If this AE Title and its network address and port are known, InQuire will initiate an association with the C-MOVE Destination AE with the required Storage Service Class Presentation Contexts determined from information held in the Insignia Database for the SOP Instances in question.

The Insignia PACS products (not the Vendor-Neutral Archive) also have automatic routing rules and user initiated actions which may result in InQuire being triggered to send a set of SOP Instances to a remote DICOM Application Entity supporting the Storage Service Class as an SCP. InQuire will instigate an association with this AE requesting Presentation Contexts for the required Storage Service Classes as determined from information held in the Insignia Database for the SOP Instances in question.

Irrespective of why the association has been initiated, InQuire will update volatile demographic information in the SOP Instances to be sent to the latest data received from the Institution Information system, if a suitable data feed exists. It will also convert the SOP Instances to the Transfer Syntax required for the accepted Presentation Context.

4.1.3 Sequencing of Real World Activities

Within the real world activities, the only sequencing constraint is that SOP Instances must be C-Stored to InDigoX before a Storage Commitment request is made for them, and that Storage Commitment request should be made before the images have been deleted from the Local Storage node; however deletion is unlikely to happen for at least 6 months after the C-Store event.

4.2 AE Specifications

4.2.1 Common Application Entity Association Policies

To prevent excessive duplication of information in this Conformance Statement and hence aid clarity, some details regarding Association Establishment and error handling which are common between all Insignia Application Entities is detailed here, and referenced from the specific Application Entity Specifications which follow.

4.2.1.1 Application Context Name

When establishing an association, the DICOM standard Application Context Name for DICOM 3.0 is always offered, and when accepting an association it is always accepted:

**Table 4.2-1
DICOM Application Context**

Application Context Name	1.2.840.10008.3.1.1.1
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4.2.1.2 Policy for Association Rejection or Abort during Negotiation

Each Application Entity which listens on its configured TCP/IP Port for an incoming network connection (InList, InDigoX and InQuire) has a configured list of remote Application Entities, together with their IP addresses, from which it may accept connections. If a connection is detected from an IP address not in the configured list, the first Association Request will result in the Association being Rejected with the reason "Calling AE Title Not Recognized", and a message being logged with the Insignia database. Subsequent connections from that IP address will result in the socket being closed immediately with no attempt at association negotiation.

If the IP Address is in the configured list, the Association negotiation will proceed, but will be rejected with the specified codes under the following circumstances:

**Table 4.2-2
Association Rejection Reasons**

Result	Source	Reason/Diag	Explanation
1: rejected, permanent	1: DICOM UL service-user	2: application context name not supported	The Association Request contained an unsupported Application Context Name. An Association Request with the same parameters will not succeed at a later time

1: rejected, permanent	1: DICOM UL service-user	3: calling AE title not recognized	The Association Request contained an unrecognized Calling AE Title. An Association Request with the same parameters will not succeed at a later time unless configuration changes are made. This rejection reason occurs when the Association Acceptor has not been configured to recognize the AE Title of the Association Initiator, or the Expected IP Address for the AE Title in question has been configured incorrectly
1: rejected, permanent	1: DICOM UL service-user	7: called AE title not recognized	The Association Request contained an unrecognized Called AE Title. An Association Request with the same parameters will not succeed at a later time. This rejection reason occurs when the Association Initiator is incorrectly configured and attempts to address the Association Acceptor using the wrong AE Title
1: rejected, permanent	2: DICOM UL service-provider (ACSE related function)	2: Protocol Version Not Supported	Bit zero of the Protocol-version field in the A-ASSOCIATE-RQ PDU is not set. An association Request with the same parameters will not succeed at a later time
2: rejected, transient	3: DICOM UL service-provider (Presentation related function)	2: local limit exceeded	The (configurable) maximum number of simultaneous Associations has been reached. An Association Request with the same parameters may succeed at a later time

If the received data cannot be parsed as a valid A-ASSOCIATE-RQ PDU during Association Acceptance or as a valid A-ASSOCIATE-AC PDU during Association Initiation, an A-ABORT PDU will be sent with the following reasons:

**Table 4.2-3
Association Abort Reasons During Negotiation**

Source	Reason / Diag.	Explanation
0: DICOM UL service-user	n/a	Timeout occurred whilst waiting for data on the socket after at least one byte of the A-ASSOCIATE-RQ PDU has been received
1: DICOM UL service-provider	0: Reason not Specified	The PDU- or an Item-Field- Length was incorrect or inconsistent, hence parsing cannot be completed
1: DICOM UL service-provider	1: Unrecognized PDU	First byte received not 0x01, 0x02, 0x03, 0x04, 0x05, 0x06 or 0x07
1: DICOM UL service-provider	2: Unexpected PDU	First byte received not 0x01
1: DICOM UL service-provider	4: Unrecognized PDU parameter	Item-type byte not one of 0x10, 0x20, 0x21, 0x30, 0x40, 0x50 or 0x51 to 0xFF
1: DICOM UL service-provider	5: Unexpected PDU Parameter	Recognized Item-type not valid in the context it was received
1: DICOM UL service-provider	6: Invalid PDU Parameter Value	In an A-ASSOCIATE-AC PDU, either bit zero of the Protocol-version field is not set, or the Application Context name is not supported

If all Presentation Contexts in an Association Request are rejected, the Application Entity will respond with an A-ASSOCIATE-AC PDU, listing the reason for not accepting each Presentation Context. It is expected that the peer will then Release the Association immediately.

4.2.1.3 Association Termination

It is expected that the party which initiates the Association will under normal circumstances Release the Association in an orderly fashion when it has no further Commands to be performed or Events to notify.

If the Insignia Application Entity is shutdown whilst an association is in progress, an A-RELEASE-RQ PDU will be issued.

If the Insignia Application Entity encounters a protocol error during the exchange of P-DATA-TF PDUs or a response to a Release Request caused by Application shutdown is not received within 2500ms, an A-ABORT PDU will be issued, with the following reasons given:

**Table 4.2-4
Association Abort Reasons During Data Exchange**

Source	Reason / Diag.	Explanation
0: DICOM UL service-user	n/a	Timeout occurred after at least one byte of PDU has been received or no response to Release RQ after 2500ms during Application Entity shutdown
1: DICOM UL service-provider	1: Unrecognized PDU	First byte of PDU not 0x01, 0x02, 0x03, 0x04, 0x05, 0x06 or 0x07
1: DICOM UL service-provider	2: Unexpected PDU	First byte of PDU not 0x04, 0x05, or 0x07 (or 0x06 if Release RQ already sent)
1: DICOM UL service-provider	6: Invalid PDU Parameter Value	<ul style="list-style-type: none"> • Presentation Context of the first received Presentation Data Value (PDV) fragment of a message was not accepted during negotiation • Presentation Context of a PDV which is not the first fragment of a message does not match the Presentation Context of the previous PDV • Failed to Parse a Command Set received over the Association

If an Abort PDU is received or the Network connection is lost, the Insignia Application Entity will internally abort the current Command it is processing or has issued over the Association and log appropriate messages to the Application's Error Log. The resources related to the Association will be released and the Application Entity will await new Association requests or internal commands to initiate a new Association.

4.2.2 InList Application Entity Specification

4.2.2.1 SOP Classes

InList provides Standard Conformance to the following DICOM V3.0 SOP Classes:

**Table 4.2-5
SOP Classes for InList AE**

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	No	Yes

4.2.2.2 Association Policies

4.2.2.2.1 General

See **4.2.1 Common Application Entity Association Policies** for Application Context Name and Association Rejection and Termination policies.

InList will never initiate Associations; it continuously listens for Association Requests from external DICOM AE's. It will accept Associations for the Verification and Modality Worklist C-FIND services.

4.2.2.2.2 Number of Associations

The maximum number of simultaneous associations that InList will accept is configurable, and defaults to 5. There is no restriction within the configured limit for the maximum number of simultaneous associations acceptable from any given remote Application Entity.

Table 4.2-6
Number of Simultaneous Associations as an Association Acceptor for InList

Maximum number of Simultaneous Associations	5 (Configurable)
---	------------------

4.2.2.2.3 Asynchronous Nature

The maximum number of asynchronous transactions that InList will allow to be invoked over a given association is 3.

Table 4.2-7
Asynchronous nature as an Association Acceptor for InList

Maximum number of outstanding asynchronous transactions	3
---	---

4.2.2.2.4 Implementation Identifying Information

InList has the Implementation Class UID and Implementation Version Name specified in **Table 4.2-8**. The Implementation Version Name matches the version number of the InList executable, which is currently 1.0.1.0. All versions of InList in the 1.0.x.y family will adhere to this Conformance Statement. When conformance changes, the version will become 1.1.x.y and a new Conformance Statement will be issued.

Table 4.2-8
DICOM Implementation Class and Version for InList AE

Implementation Class UID	1.2.840.113773.7.108
Implementation Version Name	1.0.x.y (currently 1.0.1.0)

4.2.2.3 Association Initiation Policy

InList does not initiate Associations

4.2.2.4 Association Acceptance Policy

4.2.2.4.1 Activity: Imaging Device Issues Request for Modality Worklist Information

4.2.2.4.1.1 Description and sequencing of Activities

When InList accepts an Association with a Presentation Context for a supported SOP Class, the remote Application Entity can send any number of CEcho or Modality Worklist CFind requests to which InList will respond as appropriate; the remote Application Entity should release the Association when no further commands are to be sent. When processing a CFind request, the resulting Insignia Database query will run to completion before any normal responses are sent; depending on the specified Matching Keys, some queries will take longer than others. If a C-CANCEL-FIND-RQ is received while the Database Query is in progress, a response with the status Cancelled will be sent immediately; the association can then be released or another CFind request sent as required by the SCU.

4.2.2.4.1.2 Accepted Presentation Contexts

InList will accept Presentation Contexts for the Abstract Syntax / Transfer Syntax combinations listed in **Table 4.2-9**. Note that all Transfer Syntaxes are acceptable for the Verification SOP Class as there is no Information Object associated with the Service. Where multiple Transfer Syntaxes are offered in a Presentation Context for a given Abstract Syntax in the Association Request, the first supported Transfer Syntax will be selected for that Presentation Context.

Table 4.2-9
Accepted Presentation Contexts by InList

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Any		SCP	None
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	Implicit Little Endian	1.2.840.10008.1.2	SCP	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

Note: Modality Worklist CFind Extended Negotiation - InList supports fuzzy semantic matching on Person Name

4.2.2.4.1.3 SOP Specific Conformance for Verification SOP Class

InList provides standard conformance to the Verification SOP Class as an SCP.

4.2.2.4.1.4 SOP Specific Conformance for Modality Worklist Query SOP Class

InList supports matching on the keys listed in **Table 4.2-10**, of which those marked (*) are Optional according to the Modality Worklist Information Model definition in Table K.6-1 of the DICOM Standard (PS 3.4-K.6.1.2.2).

Fuzzy semantic Person Name matching is performed on Patient Name and Scheduled Performing Physician Name using Microsoft SQL Server soundex functionality. This matching is also case-insensitive. The Specific Character Set attribute (0008,0005) is ignored and not included in the CFind Results Information Objects.

**Table 4.2-10
InList Modality Worklist Query Supported Matching Keys**

Description	Tag	Remark
Scheduled Procedure Step Sequence	(0040,0100)	
> Scheduled Station AE	(0040,0001)	
> Scheduled Procedure Step Start Date	(0040,0002)	
> Scheduled Procedure Step Start Time	(0040,0003)	
> Modality	(0008,0060)	
> Scheduled Performing Physician Name	(0040,0006)	Case Insensitive Fuzzy Matching
> Scheduled Procedure Step Location	(0040,0011)	*
> Scheduled Procedure Step Status	(0040,0020)	*
Requested Procedure Priority	(0040,1003)	*
Accession Number	(0008,0050)	*
Patient Name	(0010,0010)	Case Insensitive Fuzzy Matching
Patient ID	(0010,0020)	Single Value Matching

InList will include the return key attributes in **Table 4.2-11** when they are present in the query request. The semantic governing the presence of data for Type 2 and Conditional fields is specified. Requests for matching on attributes not in this table will result in a warning status in the C-Find response.

**Table 4.2-11
InList Modality Worklist Query Return Keys**

Description	Tag	Return Type	Remark
Scheduled Procedure Step			
Scheduled Procedure Step Sequence	(0040,0100)	1	One Item will be returned
> Scheduled Station AE	(0040,0001)	1	
> Scheduled Procedure Step Start Date	(0040,0002)	1	
> Scheduled Procedure Step Start Time	(0040,0003)	1	
> Modality	(0008,0060)	1	
> Scheduled Performing Physician's Name	(0040,0006)	2	Populated if known
> Scheduled Procedure Step Description	(0040,0007)	1C	Always populated, value matches Protocol Code SQ > Code Meaning
> Scheduled Station Name	(0040,0010)	2	Always empty
> Scheduled Procedure Step Location	(0040,0011)	2	Populated if known
> Scheduled Protocol Code Sequence	(0040,0008)	1C	Always populated with one Item
>> Code Value	(0008,0100)	1	
>> Coding Scheme Designator	(0008,0102)	1	"INSIGNIA PRIVATE" or as configured for Institution
>> Coding Scheme Version	(0008,0103)	3	Always empty
>> Code Meaning	(0008,0104)	3	Will match SPS Description
> Pre-Medication	(0040,0012)	2C	Always empty
> Scheduled Procedure Step ID	(0040,0009)	1	
> Requested Contrast Agent	(0032,1070)	2C	Always empty
> Scheduled Procedure Step Status	(0040,0020)	3	"SCHEDULED" or "ARRIVED"
Requested Procedure			
Requested Procedure ID	(0040,1001)	1	
Requested Procedure Description	(0032,1060)	1C	Always populated, value matches Procedure Code SQ > Code Meaning
Requested Procedure Code Sequence	(0032,1064)	1C	Always populated with one Item

> Code Value	(0008,0100)	1	
> Coding Scheme Designator	(0008,0102)	1	“INSIGNIA PRIVATE” or as configured
> Coding Scheme Version	(0008,0103)	3	Always empty
> Code Meaning	(0008,0104)	3	Will match RQP Description
Study Instance UID	(0020,000D)	1	
Referenced Study Sequence	(0008,1110)	2	Always empty
Requested Procedure Priority	(0040,1003)	2	Always populated
Patient Transport Arrangements	(0040,1004)	2	Always empty
Requested Procedure Comments	(0040,1400)	3	
Names of Intended Recipients of Results	(0040,1010)	3	Zero or One value will be returned
Imaging Service Request			
Accession Number	(0008,0050)	2	Always populated
Requesting Physician	(0032,1032)	2	Populated if known
Referring Physician’s Name	(0008,0090)	2	Populated if known
Requesting Service	(0032,1033)	3	
Visit Identification			
Admission ID	(0038,0010)	2	Populated if known
Visit Status			
Current Patient Location	(0038,0300)	2	Populated if known
Visit Relationship			
Referenced Patient Sequence	(0008,1120)	2	Always empty
Patient Identification			
Patient Name	(0010,0010)	1	
Patient ID	(0010,0020)	1	
Other Patient IDs	(0010,1000)	3	Zero or One value will be returned
Patient Demographic			
Patient DOB	(0010,0030)	2	Always populated
Patient Sex	(0010,0040)	2	Always populated
Patient’s Weight	(0010,1030)	2	Always empty
Confidentiality constraint on patient data	(0040,3001)	2	Always empty
Patient Comments	(0010,4000)	3	
Patient Medical			
Patient State	(0038,0500)	2	Always empty
Pregnancy Status	(0010,21C0)	2	Always empty
Medical Alerts	(0010,2000)	2	Always empty
Contrast Allergies	(0010,2100)	2	Always empty
Special Needs	(0038,0050)	2	Always empty

InList will return the following statuses in the course of handling a Modality Worklist CFind request:

**Table 4.2-12
InList Modality Worklist Query Response Status Reasons**

Service Status	Further Meaning	Error Code	Reasons
Failure	Identifier Does Not Match SOP Class	A900	The Identifier was missing or could not be interpreted as a Modality Worklist Information Object

	Unable to Process	C000	The Insignia Database query to retrieve the worklist matches failed. Full details will be logged in the InList error log. Error Comment (0000,0902) will read "Failed to process Modality Worklist Query"
Cancelled	Matching terminated due to Cancel Request	FE00	The Cancelled status will be set on the next response returned after receiving the Cancel Request
Success	Matching is complete	0000	All Pending matches have been sent
Pending	Matches are continuing – all requested Optional Keys were supported	FF00	Response contains an Information Object representing the match containing all requested keys
	Matches are continuing – Warning that one or more Optional Keys were not supported	FF01	Response contains an Information Object representing the match, but some requested optional keys were not supported - these are logged in the InList error log

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**.

4.2.3 InDigoX Application Entity Specification

4.2.3.1 SOP Classes

InDigoX provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 4.2-13
SOP Classes for InDigoX AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Storage Commitment Push Model	1.2.840.10008.1.20.1	No	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	No	Yes
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	No	Yes
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	No	Yes
Digital Mammography XRay Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	No	Yes
Digital Mammography XRay Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	No	Yes
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	No	Yes
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	No	Yes
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	No	Yes
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	No	Yes
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	No	Yes
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	No	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	No	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	No	Yes
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	No	Yes
Enhanced MR Colour Image Storage	1.2.840.10008.5.1.4.1.1.4.3	No	Yes
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5	No	Yes
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	No	Yes

Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	No	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	No	Yes
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	No	Yes
Multi-frame Greyscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	No	Yes
Multi-frame Greyscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	No	Yes
Multi-frame True Colour Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	No	Yes
Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	No	Yes
Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	No	Yes
Pseudo-Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	No	Yes
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	No	Yes
XA/XRF Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.5	No	Yes
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	No	Yes
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	No	Yes
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	No	Yes
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	No	Yes
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	No	Yes
Segmentation SOP Class	1.2.840.10008.5.1.4.1.1.66.4	No	Yes
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	No	Yes
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	No	Yes
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	No	Yes
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	No	Yes
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	No	Yes
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	No	Yes
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	No	Yes
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	No	Yes
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	No	Yes
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	No	Yes
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	No	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	No	Yes
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	No	Yes
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	No	Yes
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	No	Yes

4.2.3.2 Association Policies

4.2.3.2.1 General

See **4.2.1 Common Application Entity Association Policies** for Application Context Name and Association Rejection and Termination policies.

InDigoX can both initiate Associations and listen for Association Requests from Remote AEs. It will accept Associations for Verification, Storage and Storage Commitment Push Model Services. It will propose Associations only for the Storage Commitment Push Model Service.

4.2.3.2.2 Number of Associations

The maximum number of simultaneous associations that InDigoX will accept is configurable, and defaults to 5. There is no restriction within this limit for the maximum number of simultaneous associations acceptable from any given remote Application Entity. InDigoX may at any time initiate a single Association for Storage Commitment N-EVENT-REPORT notification irrespective of how many other Associations it is currently handling.

Table 4.2-14
Number of Simultaneous Associations for InDigoX

Maximum number of simultaneous requested Associations	5 (Configurable)
Maximum number of simultaneous proposed Associations	1

4.2.3.2.3 Asynchronous Nature

The maximum number of asynchronous transactions that InDigoX will allow to be invoked over a given association is 3. The maximum number of asynchronous transactions that InDigoX will offer to invoke over a given association is 10 (though in reality will only be 1). Where a CStore SCU can take advantage of the asynchronous window, it has been shown to significantly increase storage throughput.

Table 4.2-15
Asynchronous nature of InDigoX

Maximum number of asynchronous operations performed	3
Maximum number of asynchronous operations invoked	10

There is no limit to the number of outstanding Storage Commitment requests that can be received by InDigoX.

4.2.3.2.4 Implementation Identifying Information

InDigoX has the Implementation Class UID and Implementation Version Name specified in **Table 4.2-16**. The Implementation Version Name matches the version number of the InDigoX executable, which is currently 1.0.10.0. All versions of InDigoX in the 1.0.x.y family will adhere to this Conformance Statement. When conformance changes, the version will become 1.1.x.y and a new Conformance Statement will be issued.

Table 4.2-16
DICOM Implementation Class and Version for InDigoX AE

Implementation Class UID	1.2.840.113773.7.105
Implementation Version Name	1.0.x.y (currently 1.0.10.0)

4.2.3.3 Association Initiation Policy

4.2.3.3.1 Activity: Storage Commitment Notification over new Association

4.2.3.3.1.1 Description and Sequencing of Activities

A Storage Commitment request is deemed complete when all SOP Instances associated with it are either assigned an error condition or are robustly archived - the meaning of robustly archived is configurable by the Institution, but typically means that a SOP Instance is archived on two separate long-term storage nodes in the system. If all SOP Instances are robustly archived when the Storage Commitment request is made, InDigoX will attempt to send the N-EVENT-REPORT notification on the requesting Association; otherwise InDigoX polls the Insignia Database once a minute for completed Storage Commitment requests.

When completed requests are detected for a given Remote AE by this database poll, InDigoX will initiate a new Association in order to send the Storage Commitment Push Model Notifications (N-EVENT-REPORT). If there are multiple outstanding Notifications to be sent to the remote AE, InDigoX will attempt to send them all over a single Association rather than requesting a new Association for each one. The Association will be released when all the N-EVENT-REPORTs for the peer AE have been sent. If the peer responds to the N-EVENT-REPORT with a status other than successful, or if an Association could not be initiated, the notification attempt will be retried every minute until it is successful.

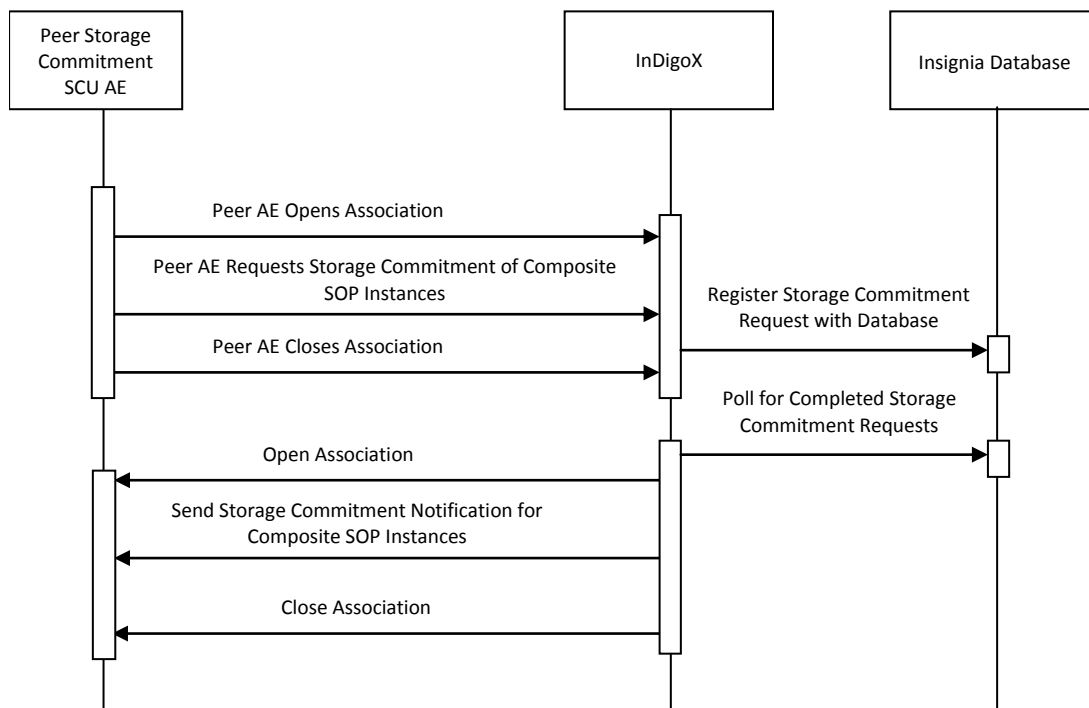


Figure 4.2-1
Sequencing of Activity: Send Commitment Notification over new Association

4.2.3.3.1.2 Proposed Presentation Contexts

InDigoX will propose the following Presentation Context:

**Table 4.2-17
Proposed Presentation Contexts by InDigoX**

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Storage Commitment Push Model	1.2.840.10008.5.1.20.1	Implicit Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

4.2.3.3.1.3 SOP Specific Conformance for Storage Commitment SOP Class

InDigoX will not include the Media File-Set ID & UID attributes (0088,0130) and (0088,0140), nor will it include the Retrieve AE Title attribute (0008,0054), though the SOP Instances in question (as with all SOP Instances in the Insignia System) can always be retrieved via the Inquire AE as described later in the document.

Table 4.2.18 lists the possible Storage Commitment Failure Reasons (0008,1197) that may appear for SOP Instances in the N-EVENT-REPORT Failed SOP Sequence (0008,1198). In the case of the ‘No Such Object Instance’ failure occurring due to the object having been migrated from the Local Storage, a subsequent Storage Commitment request for the SOP Instance can be made to succeed by either causing the Insignia System to internally route the SOP Instances to the Local storage, or the requesting AE can repeat the C-Store of the SOP Instance to InDigoX.

**Table 4.2-18
Possible Values for InDigoX Storage Commitment N-EVENT-REPORT Failure Reason (0008,1197)**

Failure Code	Reason
0112 No Such Object Instance	The SOP Instance is not present on the Local Storage – there are three possible reasons for this: <ul style="list-style-type: none"> • it has not yet been received • InDigoX received the image, but the Insignia Database refused to register the details due to data inconsistency • it has been migrated off the Local Storage node – this is unlikely to happen for at least 6 months after the C-Store event
0119 Class Instance Conflict	The SOP Instance is present, but does not have the SOP Class specified
0131 Duplicate Transaction UID	The Transaction UID already exists for an outstanding Storage Commitment Request

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. In the event of errors causing an unexpected termination of an Association, Storage Commitment notifications will be retried every minute until a successful N-EVENT-REPORT response is received for the Transaction.

4.2.3.4 Association Acceptance Policy

4.2.3.4.1 Activity: Receipt of SOP Instances and Storage Commitment Requests

4.2.3.4.1.1 Description and sequencing of Activities

When InDigoX accepts an Association with a Presentation Context for a supported SOP Class, the remote Application Entity can send any number of CEcho, CStore or Storage Commitment Requests. When a Storage Commitment Request is received, the details are logged with the Insignia Database and if all SOP Instances are already robustly archived (see 4.2.3.3.1), InDigoX will attempt to send an N-EVENT-REPORT notification over the existing Association; otherwise an N-EVENT-REPORT will be sent on a new association when completion is detected as described in section 4.2.3.3.1. The remote Application Entity can release the Association at any point when no further commands are to be sent.

4.2.3.4.1.2 Accepted Presentation Contexts

Depending on the identity of the requesting AE, InDigoX will accept a subset of the Presentation Contexts for the Abstract Syntax / Transfer Syntax combinations listed in **Table 4.2-19**. Note, for clarity and to avoid unnecessary duplication of information, the Storage SOP Class Abstract Syntaxes from **Table 4.2-13** share one entry as they all support the same set of Transfer Syntaxes, Role and Extended Negotiation.

- The actual set of supported Abstract Syntaxes from the list in **Table 4.2-13** is configurable per remote AE, which allows certain SOP Classes to be supported for some remote AEs but not others.
- The set of supported Transfer Syntaxes is also configurable per remote AE. This can be used to eliminate known issues with some manufacturers' encodings of Undefined Length UN Sequences, and incorrect encoding of Lossless JPEG pixel data, for example.

Note that all Transfer Syntaxes are acceptable for the Verification SOP Class as there is no Information Object associated with the Service. Where multiple Transfer Syntaxes are offered in a Presentation Context for a supported Abstract Syntax, the first supported Transfer Syntax will be selected for that Presentation Context.

Table 4.2-19
Accepted Presentation Contexts by InDigoX

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Any		SCP	None
Storage Commitment Push Model	1.2.840.10008.5.1.20.1	Implicit Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
The Storage SOP Classes in Table 4.2-13	See Table 4.2-13	Implicit Little Endian	1.2.840.10008.1.2	SCP	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57		
		JPEG Lossless, Non-Hierarchical - First-Order Prediction (Process 14 [selection value 1])	1.2.840.10008.1.2.4.70		

Note: Storage Service Extended Negotiation – if extended negotiation is requested, InDigoX will indicate that it is a Level 2 SCP, supports Signature Level 1, and may coerce Data Elements.

4.2.3.4.1.3 SOP Specific Conformance for Verification SOP Class

InDigoX provides standard conformance to the Verification SOP Class as an SCP.

4.2.3.4.1.4 SOP Specific Conformance for Storage SOP Classes

When InDigoX receives a Storage request, it will attempt to write the received SOP Instance to the Local Storage Node and register certain details of the object with the Insignia System Database. Where pixel data exists in the object this is encapsulated on the local storage using the JPEG Lossless, Non-Hierarchical (Process 14) syntax.

InDigoX is a Level 2 (Full) conformant Storage SCP, so where the CStore succeeds, all Data Elements from the original object will be preserved, including Private and SOP Class Extended Elements. No special treatment is given to the Lossy Image Compression (0028,2110) attribute – it is preserved as received. Any Digital Signatures associated with the object are not preserved or replaced (Signature Level 1).

Once stored the images are normally preserved on the Insignia System forever (though some deployments of the Disaster Recovery PACS may specify a maximum capacity of stored data. Once this capacity is reached, objects are deleted in a reverse time order to make space for newly acquired images). All objects stored to an InDigoX instance can be retrieved from the InQUIRE component on any Departmental Server node in the system.

Coercion of data in the object will occur to update volatile demographics to the latest data received from the Institution Information System, however this coercion is performed by the InQUIRE CStore SCU when objects are retrieved from the system rather than when they are stored – see later section. The only Data Element that InDigoX will alter is the SOP Instance UID, and only in the case where an object is sent to the Insignia System, rejected as part of the QA process, and then fixed and resent from the modality with the same SOP Instance. In this case the object with the original SOP Instance UID still exists in the Insignia System, so a new SOP Instance is generated for the newly stored object.

If a Duplicate SOP Instance for a non-rejected object is sent to InDigoX (as can happen if some objects in a multi-object series fail on the first send attempt and the whole series is subsequently resent), the new SOP will be ignored, and the CStore response status will either contain the status 0x0111: Duplicate SOP Instance, or, because that causes many modalities to terminate the association immediately, InDigoX can be configured to always return 0x0000: Success in this case.

**Table 4.2-20
InDigoX CStore Response Status Reasons**

Service Status	Further Meaning	Error Code	Reasons
Success	Success	0000	The Composite SOP Instance has been successfully received, stored and registered with the Insignia Database
Warning	Data Set does not match SOP Class	B007	If the SOP Class of the Data Set is different to the SOP Class in the Command Set, the object will be stored and registered, but this warning returned
Failure	Refused: Out of Resources	A700	Failed to write the object to local storage, probably because the local disk is full. Full details will be logged in the InDigoX error log. Error Comment (0000,0902) will read "Out of Resources"

	Cannot Understand	C000	Failed to register the object with the Insignia Database. Full details will be logged in the InDigoX error log. Error Comment (0000,0902) will read "Failed to extract required data from object"
	Duplicate SOP Instance	0111	If configured to do so, InDigoX will return this status if a SOP Instance is received that already exists on the Insignia System

If a communication failure occurs during the course of an Association, any objects that have been stored and registered with the Insignia System are preserved, irrespective of whether the CStore Response has been successfully sent. If the communication failure occurs whilst part-way through receiving an object, that object will be discarded. The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**.

4.2.3.4.1.5 SOP Specific Conformance for Storage Commitment SOP Classes

A remote AE can use the Storage Commitment service to request that it is notified when the Insignia System has committed to the long-term ownership of a set of SOP Instances. A modality may use this information to determine when it is free to purge objects from its storage. The semantic of long-term ownership or robust archiving is configurable in the Insignia System, but is typically that the SOP Instance has been copied to two long-term storage nodes in the system. Once on long-term storage, the SOP Instances will exist on the Insignia System for the life of the system – this implies that where a Disaster Recovery PACS has been deployed with limited capacity, Storage Commitment will not be offered as a service.

SOP Instances for which Storage Commitment has been confirmed are always available for Query / Retrieve via any Inquire component on a Departmental Server node in the Insignia System. Volatile demographic data will be updated when a SOP Instance is retrieved, see Inquire conformance in this document.

The Media File-Set ID and UID Attributes are not supported.

When InDigoX receives a Storage Commitment N-ACTION primitive, the Transaction UID and the set of referenced SOP Instance UIDs are registered with the Insignia Database. If all SOP Instances are already robustly archived and no error conditions apply, InDigoX will attempt to send the N-EVENT-REPORT notification over the existing association. Where a Storage Commitment failure has occurred, the Association has already been closed, or not all SOP Instances have been archived, InDigoX will poll for the status of the transaction once a minute and open a new Association for the N-EVENT-REPORT notification when the Storage Commitment is complete, as described in section **4.2.3.3**.

InDigoX will respond to the N-ACTION request with one of the following statuses:

**Table 4.2-21
InDigoX Storage Commitment N-ACTION Response Statuses**

Status	Further Meaning	Error Code	Reason
Success	Success	0000	Transaction UID and Referenced SOP Instances registered with Insignia System
Error	No Such Action Type	0123	Action Type was not 1
	Invalid Argument Value	0115	Required Attributes not present in the N-Action primitive. The Offending Element List data element (0000,0901) will be populated, as will Error Comment (0000,0902)
	Processing Failure	0110	The database call to register the Transaction UID and Referenced SOP Instances failed. Error Comment (0000,0902) will read "Failed to register Storage Commitment request"

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**.

4.2.4 InPort Application Entity Specification

4.2.4.1 SOP Classes

InPort provides Standard Conformance to the following DICOM V3.0 SOP Classes:

**Table 4.2-22
SOP Classes for InPort AE**

SOP Class Name	SOP Class UID	SCU	SCP
Patient Root Query / Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	Yes	No
Patient Root Query / Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	Yes	No
Study Root Query / Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	No
Study Root Query / Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes	No
Patient/Study Only Query/Retrieve Information Model-FIND	1.2.840.10008.5.1.4.1.2.3.1	Yes	No
Patient/Study Only Query/Retrieve Information Model-MOVE	1.2.840.10008.5.1.4.1.2.3.2	Yes	No

4.2.4.2 Association Policies

4.2.4.2.1 General

See 4.2.1 Common Application Entity Association Policies for Application Context Name and Association Termination policies.

InPort only initiates Associations with remote AEs, it will not respond to incoming Association Requests.

4.2.4.2.2 Number of Associations

InPort will initiate one Association at a time over which it will perform a single CFind operation, and at the same time may have a configurable number of Associations (default is 5) open, performing a single CMove operation on each one. These Associations may be against the same or different remote AEs.

**Table 4.2-23
Number of Simultaneous Associations as an Association Requester for InPort**

Maximum number of Simultaneous Associations	6 (1 CFind, Configurable number for CMove)
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4.2.4.2.3 Asynchronous Nature

InPort will offer to invoke up to 10 asynchronous transactions on each Association, however in reality it will never invoke more than 1.

**Table 4.2-24
Asynchronous nature as an Association Initiator for InPort**

Maximum number of outstanding asynchronous transactions invoked	10
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4.2.4.2.4 Implementation Identifying Information

InPort has the Implementation Class UID and Implementation Version Name specified in **Table 4.2-25**. The Implementation Version Name matches the version number of the InPort executable, which is currently 1.2.0.0. All versions of InPort in the 1.2.x.y family will adhere to this Conformance Statement. When conformance changes, the version will become 1.3.x.y and a new Conformance Statement will be issued.

**Table 4.2-25
DICOM Implementation Class and Version for InPort AE**

Implementation Class UID	1.2.840.113773.7.107
Implementation Version Name	1.2.x.y (currently 1.2.0.0)

4.2.4.3 Association Initiation Policy

4.2.4.3.1 Activity: Insignia System Interrogates Remote System

4.2.4.3.1.1 Description and Sequencing of Activities

The Insignia System may need to interrogate a remote system for the information it holds regarding a certain Patient, Study or booking. There are several scenarios where this is necessary, for example:

- Within an Institution, when the Insignia Breast Screening PACS receives a booking for a Patient from the RIS / NBSS information feed, it may wish to interrogate an Institution’s Radiology PACS for the details of any relevant studies in the Patient’s imaging history
- Within an Institution, the Disaster Recovery PACS and VNA products are used for data duplication, which may involve querying an Institution’s PACS for details of studies taken on a certain date / date range
- Where multiple Institutions collaborate, the Insignia PACS may wish to interrogate a collaborating PACS for details of a patient’s history, either after receiving a booking for the patient or based on a User’s request for information

Each CFind request will occur on a new Association, which will be released once the final response has been received. If no response has been received within 60 seconds or the InPort service is shutdown while a CFind request is in progress, a C-FIND-CANCEL-RQ will be sent before the Association is released.

Depending on the information required by the Insignia System the sequence of CFind requests will follow one of the following patterns:

4.2.4.3.1.1.1 Patient Demographic Query

A User wishes to find Patients that match a given Patient Name, Date of Birth, Sex combination.

- InPort opens a new Association
- A PATIENT Level (or STUDY Level if only the Study Root SOP Class was accepted) query is performed - the Patient Name field may contain wild cards.
- The Association is released
- The Matches are presented to the User, who will then probably select one patient on which to do a Patient History Query

4.2.4.3.1.1.2 Patient History Query

A User or the System wishes to retrieve details of the imaging history of a patient with a known Patient ID.

- InPort opens a new Association
- A STUDY Level query is performed, matching on the Patient ID
- The Association is released
- Then for each Study match:
 - InPort opens a new Association
 - A SERIES Level query is performed, matching on the Study Instance UID
 - The Association is released
 - The Study and Series results are reported to the System, which will present them to the User if required

4.2.4.3.1.1.3 Patient ID Query from Booking Reference

A User or the System wishes to retrieve details of the imaging history of the patient associated with a known booking reference, but the Patient ID is not known.

- InPort opens a new Study Root Association
- A STUDY Level query is performed, matching the booking on either Study ID or Accession number, depending on configuration
- The Patient ID is taken from the responses and reported to the System
- The Association is Released
- A Patient History Query is performed as above with the now known Patient ID

4.2.4.3.1.1.4 Explicit Study Query

The System wishes to know the details of the Studies associated with a given booking or date range

- InPort opens a new Study Root Association
- A STUDY Level query is performed, matching on Study Date / Time, or against the Booking Reference in the Study ID or Accession Number field, depending on configuration
- The Association is Released
- The matching studies are reported to the system

4.2.4.3.1.2 Proposed Presentation Contexts

InPort will propose Presentation Contexts from the following set (one Presentation Context per Abstract Syntax, each with multiple Transfer Syntaxes). InPort will only perform Hierarchical Queries, so Study Root

is always proposed, Patient Root is proposed if Patient ID is known or a PATIENT Level query is requested, Patient / Study Only is proposed if the Level is PATIENT or the Level is STUDY and Patient ID is known.

**Table 4.2-26
Presentation Contexts proposed by InPort for Remote AE Query**

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Patient Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.1.1	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Study Root Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit Little Endian	1.2.840.10008.1.2	SCU	
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Patient / Study Only Q/R Information Model – FIND	1.2.840.10008.5.1.4.1.2.3.1	Implicit Little Endian	1.2.840.10008.1.2	SCU	
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

Note: Extended Negotiation – InPort does not request Relational Queries or combined Date-Time matching, but will request Fuzzy Semantic person name matching for the Patient Demographic Query if requested to do so by the User.

When a CFind command is then issued on the Association, the most appropriate Presentation Context accepted from those offered will be used. For the scenarios outlined above, the Abstract Syntax orders of preference are as follows:

**Table 4.2-27
Order of Preference for Presentation Contexts Usage for InPort Remote AE Query**

Scenario	Abstract Syntax Order of Preference		
Patient Demographic Query	Patient Root	Patient / Study Only	Study Root
Patient History Query	Study Root	Patient Root	Patient / Study Only
• Associated Series Level Query	Study Root	Patient Root	-
Patient ID Query from Booking Reference	Study Root	-	-
Explicit Study Query	Study Root	-	-

4.2.4.3.1.3 SOP Specific Conformance for Patient Root and Patient/Study Only CFind

InPort may perform Patient Root and Patient / Study Only queries at the PATIENT or STUDY level. For the Patient Root SOP Class it may also perform SERIES level queries. IMAGE level queries will not be performed.

Neither Relational Queries nor combined date and time matching will be requested. The user may request that the Patient Name in a Patient Demographic Query be matched using Fuzzy Semantic, in which case InPort will attempt to negotiate Fuzzy Semantic Person Name matching.

Specific Character Set is not included in the query, and will be ignored if present in a response. Timezone Offset from UTC is not included in the query and will be ignored if present in a response. The following tables specify the contents of the Request Identifiers for each Query Level:

**Table 4.2-28
InPort Patient Root & Patient / Study Only PATIENT Level Request Identifier**

Name	Tag	Matching Type
Patient Name	(0010,0010)	Single Value, Wild Card, Universal
Patient ID	(0010,0020)	Single Value, Universal
Patient Date of Birth	(0010,0030)	Single Value, Universal
Patient Sex	(0010,0040)	Single Value, Universal
Other Patient IDs	(0010,1000)	Universal
Number of Patient Related Studies	(0020,1200)	Universal
Number of Patient Related Series	(0020,1202)	Universal
Number of Patient Related Instances	(0020,1204)	Universal

Note: if the Patient ID is provided for Single Value matching, all other fields will be specified for Universal Matching

**Table 4.2-29
InPort Patient Root & Patient / Study Only STUDY Level Request Identifier**

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value
Study Instance UID	(0020,000D)	Universal
Study Date	(0008,0020)	Universal
Study Time	(0008,0030)	Universal
Accession Number	(0008,0050)	Universal
Study ID	(0020,0010)	Universal
Study Description	(0020,1030)	Universal
Referring Physician	(0008,0090)	Universal
Name of Physician(s) Reading Study	(0008,1060)	Universal
Number of Study Related Series	(0020,1206)	Universal
Number of Study Related Instances	(0020,1208)	Universal

**Table 4.2-30
InPort Patient Root SERIES Level Request Identifier**

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value
Study Instance UID	(0020,000D)	Single Value
Modality	(0008,0060)	Universal
Series Instance UID	(0020,000E)	Universal
Series Number	(0020,0011)	Universal
Series Description	(0008,103E)	Universal
Series Date	(0008,0021)	Universal
Series Time	(0008,0031)	Universal
Body Part Examined	(0018,0015)	Universal
Performing Physician	(0008,1050)	Universal
Patient Position	(0018,5100)	Universal
Frame Of Reference	(0020,0052)	Universal
Device Model	(0008,1090)	Universal
Manufacturer	(0008,0070)	Universal
Number of Series Related Instances	(0020,1209)	Universal

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. If an error occurs during a CFind command, no results will be presented

to the Insignia Database. The Insignia System may queue the CFind request to be retried if it was generated by a system rule rather than User interaction.

4.2.4.3.1.4 SOP Specific Conformance for Study Root CFind

InPort may perform Study Root queries at the STUDY or SERIES level. IMAGE level queries will not be performed.

Neither Relational Queries nor combined date and time matching will be requested. The user may request that the Patient Name in a Patient Demographic Query be matched using Fuzzy Semantic, in which case InPort will attempt to negotiate Fuzzy Semantic Person Name matching. If a Presentation Context for the Patient Root or Patient / Study Only SOP Class has been accepted, they will be used in preference of the Study Root SOP Class for the Patient Demographic Query, for the other InPort Query use cases, Study Root CFind is the preferred Abstract Syntax.

Specific Character Set is not included in the query, and will be ignored if present in a response. Timezone Offset from UTC is not included in the query and will be ignored if present in a response. The following tables specify the contents of the Request Identifiers for each Query Level:

**Table 4.2-31
InPort Study Root STUDY Level Request Identifier**

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value, Universal
Patient Name	(0010,0010)	Single Value, Wild Card, Universal
Patient Date of Birth	(0010,0030)	Single Value, Universal
Patient Sex	(0010,0040)	Single Value, Universal
Other Patient IDs	(0010,1000)	Universal
Study Instance UID	(0020,000D)	Universal
Study Date	(0008,0020)	Single Value, Range or Universal
Study Time	(0008,0030)	Range or Universal
Accession Number	(0008,0050)	Single Value or Universal
Study ID	(0020,0010)	Single Value or Universal
Study Description	(0020,1030)	Universal
Referring Physician	(0008,0090)	Universal
Name of Physician(s) Reading Study	(0008,1060)	Universal
Number of Study Related Series	(0020,1206)	Universal
Number of Related Instances	(0020,1208)	Universal

Note: 1) If one of Patient ID, Accession Number or Study ID is provided for Single Value Matching, all other fields will be specified for Universal Matching.

2) If Study Date is provided for Range Matching, all other fields will be specified for Universal Matching.

3) If Study Date is provided for Single Value matching, Study Time will be specified for either Range matching or Universal Matching, all other fields will be specified for Universal Matching.

**Table 4.2-32
InPort Study Root SERIES Level Request Identifier**

Name	Tag	Matching Type
Study Instance UID	(0020,000D)	Single Value
Modality	(0008,0060)	Universal
Series Instance UID	(0020,000E)	Universal
Series Number	(0020,0011)	Universal

Series Description	(0008,103E)	Universal
Series Date	(0008,0021)	Universal
Series Time	(0008,0031)	Universal
Body Part Examined	(0018,0015)	Universal
Performing Physician	(0008,1050)	Universal
Patient Position	(0018,5100)	Universal
Frame Of Reference	(0020,0052)	Universal
Device Model	(0008,1090)	Universal
Manufacturer	(0008,0070)	Universal
Number of Series Related Instances	(0020,1209)	Universal

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. If an error occurs during a CFind command, no results will be presented to the Insignia Database. The Insignia System may queue the CFind request to be retried if it was generated by a system rule rather than User interaction.

4.2.4.3.2 Activity: Insignia System Requires Objects Residing on Remote System

4.2.4.3.2.1 Description and Sequencing of Activities

Once the Study Instance UIDs of the Studies contained on a Remote System for a given Patient, Booking or Study Date/ Time Range have been established (by InPort interrogation, or by other means), InPort will issue STUDY Level CMove requests for those Studies that the Insignia System calculates that it requires, or a User requests. Each CMove request will be issued on a new Association; the Association will be released when the Final Response is received. The CMove Destination will be set to the AE Title of the InDigoX Instance residing on the Departmental Server node.

4.2.4.3.2.2 Proposed Presentation Contexts

InPort will propose the following Presentation Contexts for the STUDY Level CMove request.

**Table 4.2-33
Presentation Contexts proposed by InPort for Remote AE Retrieve**

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Patient Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Study Root Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit Little Endian	1.2.840.10008.1.2	SCU	
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Patient / Study Only Q/R Information Model – MOVE	1.2.840.10008.5.1.4.1.2.3.2	Implicit Little Endian	1.2.840.10008.1.2	SCU	
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

Note: InPort will attempt to negotiate Relational Retrieval

The three Abstract Syntaxes will always be offered with Relational Retrieval extended negotiation, as this means a STUDY Level retrieval for a known Study Instance UID can be performed even if the Patient ID is not known.

If Patient ID and Study Instance UID are known, the order of preference for the Presentation Context to use for the CMove request will be Patient Root - Study Root - Patient/Study Only.

If only Study Instance UID is known, the order of preference for the Presentation Context used will be Study Root - Patient Root - Patient/Study Only. Patient Root and Patient/Study Only will only be used if the peer has accepted those Abstract Syntaxes with Relational Retrieval.

4.2.4.3.2.3 SOP Specific Conformance for Retrieve Service Classes

InPort will only invoke STUDY Level CMove requests, each of which will contain a single Study Instance UID. It will attempt to negotiate Relational Retrieval. The CMove Destination for all Retrieval Requests will be set to the AE Title of the InDigoX instance on the Departmental Server node.

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. In the event of an unexplained failure of the CMove command, the Insignia System will queue the CMove request to be retried.

4.2.4.4 Association Acceptance Policy

InPort does not accept Associations.

4.2.5 Inquire Application Entity Specification

4.2.5.1 SOP Classes

Inquire provides Standard Conformance to the following DICOM V3.0 SOP Classes:

Table 4.2-34
SOP Classes for Inquire AE

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	No	Yes
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Yes	No
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Yes	No
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Yes	No
Digital Mammography XRay Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Yes	No
Digital Mammography XRay Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Yes	No
Digital Intra-oral X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Yes	No
Digital Intra-oral X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Yes	No
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Yes	No
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Yes	No
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Yes	No
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	No
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes	No
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes	No
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	Yes	No
Enhanced MR Colour Image Storage	1.2.840.10008.5.1.4.1.1.4.3	Yes	No

Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5	Yes	No
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Yes	No
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	No
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	No
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	Yes	No
Multi-frame Greyscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Yes	No
Multi-frame Greyscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Yes	No
Multi-frame True Colour Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Yes	No
Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Yes	No
Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	Yes	No
Pseudo-Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	Yes	No
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	Yes	No
XA/XRF Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.5	Yes	No
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Yes	No
Enhanced XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	Yes	No
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Yes	No
Enhanced XRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	Yes	No
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Yes	No
Segmentation SOP Class	1.2.840.10008.5.1.4.1.1.66.4	Yes	No
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Yes	No
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Yes	No
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Yes	No
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Yes	No
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Yes	No
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Yes	No
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Yes	No
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Yes	No
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	Yes	No
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Yes	No
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Yes	No
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	No
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Yes	No
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Yes	No
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Yes	No
Patient Root Query / Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1	No	Yes
Patient Root Query / Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2	No	Yes
Study Root Query / Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	No	Yes
Study Root Query / Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	No	Yes
Patient/Study Only Query/Retrieve Information Model – FIND (Retired)	1.2.840.10008.5.1.4.1.2.3.1	No	Yes
Patient/Study Only Query/Retrieve Information Model – MOVE (Retired)	1.2.840.10008.5.1.4.1.2.3.2	No	Yes

Inquire will send Composite Objects using the Storage SOP Class that was used when the Object was received by InDigoX.

4.2.5.2 Association Policies

4.2.5.2.1 General

See **4.2.1 Common Application Entity Association Policies** for Application Context Name and Association Rejection and Termination policies.

Inquire can both initiate Associations and listen for Association Requests from Remote AEs. It will accept Associations for Verification and the Composite Object Query / Retrieve Service Classes. It will propose Associations for the Storage Service Classes.

4.2.5.2.2 Number of Associations

The maximum number of simultaneous associations that Inquire will accept is configurable, and defaults to 5. There is no restriction within this limit for the maximum number of simultaneous associations acceptable from any given remote Application Entity.

Inquire will initiate a Storage Association for each open CMove request, and in addition may initiate a configurable number (default 10) of simultaneous Storage Associations to route objects to remote AEs due to rules in the Insignia System. Within this limit, Inquire does not restrict the number of simultaneous Associations which may be open to a particular Remote AE at any given time.

**Table 4.2-35
Number of Simultaneous Associations for Inquire**

Maximum number of simultaneous requested Associations	5 (Configurable)
Maximum number of simultaneous proposed Associations	15 (Configurable)

4.2.5.2.3 Asynchronous Nature

The maximum number of asynchronous transactions that Inquire will allow to be invoked over a given association is 3. The maximum number of asynchronous transactions that Inquire will offer to invoke over a given association is 10. If agreed in the negotiation, the Storage Services will make use of the Asynchronous window when sending Objects, as it has been shown to increase throughput.

**Table 4.2-36
Asynchronous nature of Inquire**

Maximum number of asynchronous operations performed	3
Maximum number of asynchronous operations invoked	10

4.2.5.2.4 Implementation Identifying Information

Inquire has the Implementation Class UID and Implementation Version Name specified in **Table 4.2-37**. The Implementation Version Name matches the version number of the Inquire executable, which is currently 1.0.5.0. All versions of Inquire in the 1.0.x.y family will adhere to this Conformance Statement.

When conformance changes, the version will become 1.1.x.y and a new Conformance Statement will be issued.

**Table 4.2-37
DICOM Implementation Class and Version for Inquire AE**

Implementation Class UID	1.2.840.113773.7.100
Implementation Version Name	1.0.x.y (currently 1.0.5.0)

4.2.5.3 Association Initiation Policy

4.2.5.3.1 Activity: Storage of Composite Objects to Remote AE

4.2.5.3.1.1 Description and Sequencing of Activities

Inquire will initiate a new Association in response to it receiving a CMove request from a Remote AE, or when triggered to route objects to a Remote AE by rules in the Insignia System. It will attempt to send all required objects for the CMove request or the routing event, then release the Association.

4.2.5.3.1.2 Proposed Presentation Contexts

Inquire will only propose Presentation Contexts for the set of SOP Classes represented in the set of objects to send to the Remote AE. The set of proposed Transfer Syntaxes is configurable per Remote AE from the set in **Table 4.2-38**, which allows Inquire to avoid known problems with some manufacturers' incorrect implementations of Undefined Length Unknown Sequences, JPEG encoding, etc.

For each required Abstract Syntax, one Presentation Context will be offered with all peer-supported Transfer Syntaxes, and if the object contains Pixel Data, one Presentation Context will be offered with just the Transfer Syntax that represents the storage of the object on the Insignia System (currently this is Lossless JPEG, Non-Hierarchical) – this is the preferred Transfer Syntax as no encapsulation conversion will be required, and this Presentation Context will be used if accepted. **Table 4.2-38** shows the Transfer Syntaxes that may be offered, note that all Image Storage SOP Classes are treated in the same manner, so their details are not repeated in the table.

**Table 4.2-38
Presentation Contexts Proposed by Inquire**

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Pseudo-Colour Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Blending Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.4	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

XA/XRF Greyscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.5	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
Other Storage SOP Classes (Image Classes) in Table 4.2-34	See Table 4.2-34	Implicit Little Endian	1.2.840.10008.1.2	SCU	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57		
		JPEG Lossless, Non-Hierarchical - First-Order Prediction (Process 14 [selection value 1])	1.2.840.10008.1.2.4.70		

Note: Storage Service Extended Negotiation – Inquire includes the extended negotiation item in the Association Request to allow the SCP to indicate its level of support.

4.2.5.3.1.3 SOP Specific Conformance for Storage Service Classes

Inquire sends SOP Instances that have originally been received by the Insignia System via InDigoX. InDigoX is a type 2 Storage SCP, so all Optional and Private Data Elements and Functional Groups are preserved; as such, the exact set of Data Elements present in instances of each SOP Class will be detailed in the Conformance Statements of the systems that originally sent the SOP Instances to InDigoX, and cannot be defined here.

Inquire does not support Referenced Pixel Data Transfer Syntaxes.

The status contained in a CStore response will be reported to either the CMove originator as part of the pending and final responses, or the Insignia System, be it Successful, Warning or a Failure. In the event of an individual CStore command failing, a CStore attempt will still be made for all other SOP Instances in the CMove request or Insignia Routing set. The failed command will not automatically be retried but a detailed error will be written to the Inquire error log.

Inquire will not attempt to update SOP Instances from retired SOP Classes to the new SOP Classes, and it will not fall back to using a related General SOP Class if a Specialised SOP Class is rejected.

When sending images, certain Volatile Patient Demographic information will be updated to match the latest information from the Institution's information System, or where errors of hierarchy have been corrected by the Insignia System tools. Optional Fields for a given IOD will only be updated if they are already present in the SOP Instance, not added. The fields that may be updated are as follows:

**Table 4.2-39
Fields Updated by Inquire**

Field	Tag
Patient Name	(0010,0010)
Patient ID	(0010,0020)
Patient Date of Birth	(0010,0030)
Patient Sex	(0010,0040)
Other Patient ID	(0010,1000)
Study Instance UID	(0020,000D)
Study ID	(0020,0010)
Study Date	(0008,0020)
Study Time	(0008,0030)
Accession Number	(0008,0050)
Referring Physician Name	(0008,0090)
Study Description	(0008,1030)
Procedure Code Sequence	(0008,1032)
> Code Value	(0008,0100)
> Code Meaning	(0008,0104)
> Coding Scheme Designator	(0008,0102)
> Coding Scheme Version	(0008,0103)
Physician of Record Names	(0008,1048)
Performing Physician Name	(0008,1050)
Reading Physician Names	(0008,1060)
Series Instance UID	(0020,000E)
Body Part Examined	(0018,0015)

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. If the Storage Association is unexpectedly closed before a CStore Response is received for the last image, Inquire will Abort the originating CMove Association. If the Storage Association is unexpectedly closed during the Release cycle (i.e. after the last image has been sent) the associated CMove command will be completed as normal.

4.2.5.4 Association Acceptance Policy

4.2.5.4.1 Activity: Handling Query / Retrieve Requests from Remote AEs

4.2.5.4.1.1 Description and sequencing of Activities

When Inquire accepts an Association with one or more Presentation Contexts for supported SOP Classes, the remote Application Entity can send any number of CEcho, CFind or CMove requests to which Inquire will respond as appropriate; the remote Application Entity is expected to release the Association when no further commands are to be sent.

When processing a CFind request, the resulting Insignia Database query will run to completion before any normal responses are sent; depending on the specified Matching Keys, some queries will take longer than others. If a C-CANCEL-FIND-RQ is received while the Database Query is in progress or while matches are being sent, a final response with the status Cancelled will be sent immediately. The Association can then be released, or further Query/Retrieve requests sent as required by the SCU.

When processing a CMove request, Inquire initiates the Association to the CMove Destination on a separate thread. Once this Association is established successfully, Inquire will send progress messages to the CMove SCU every 200ms, or once per image if individual CStore commands are taking longer than 200ms to complete. Once the CStore Association is established, if a C-CANCEL-MOVE-RQ is received Inquire will finish sending the current CStore command, release the Association with the CMove Destination and send a CMove response with status Cancelled to the CMove SCU. The Association can then be released, or further Query/Retrieve requests sent as required by the SCU.

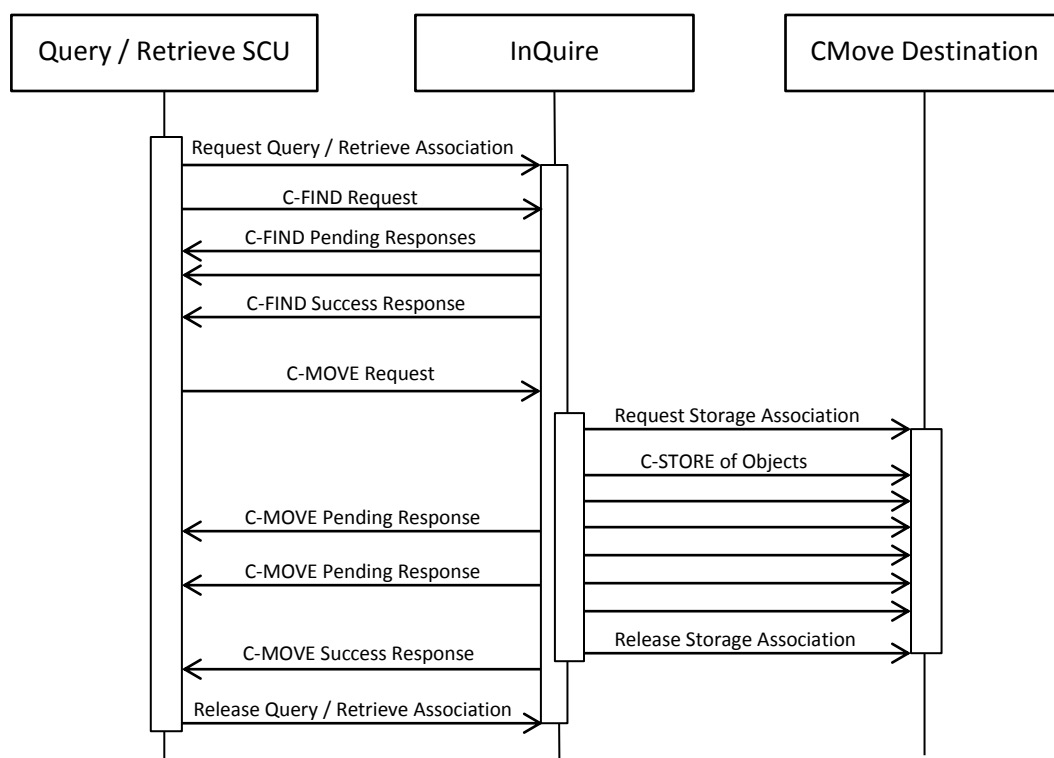


Figure 4.2-2
Sequencing of Activity: Query / Retrieve

4.2.5.4.1.2 Accepted Presentation Contexts

Inquire will accept Presentation Contexts for the Abstract Syntax / Transfer Syntax combinations listed in **Table 4.2-40**. Note that all Transfer Syntaxes are acceptable for the Verification SOP Class as there is no Information Object associated with the Service. Where multiple Transfer Syntaxes are offered in a Presentation Context for a given Abstract Syntax in the Association Request, the first supported Transfer Syntax will be selected for that Presentation Context.

**Table 4.2-40
Accepted Presentation Contexts by Inquire**

Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Any		SCP	None
Query / Retrieve Information Model SOP Classes from Table 4.2-34	See Table 4.2-34	Implicit Little Endian	1.2.840.10008.1.2	SCP	See Note
		Explicit Little Endian	1.2.840.10008.1.2.1		
		Explicit Big Endian	1.2.840.10008.1.2.2		

Note: CFind Extended Negotiation – Inquire does not support Relational Queries or combined date-time matching, but does supports fuzzy semantic matching on Person Name fields

4.2.5.4.1.3 SOP Specific Conformance for Verification Class

Inquire provides standard conformance to the Verification SOP Class as an SCP

4.2.5.4.1.4 SOP Specific Conformance for Query Service Classes

Inquire supports matching on the keys listed in **Tables 4.2-41 to 4.2-45**. Where a field is listed as Universal matching only and a value is supplied in the query, the value supplied will be ignored – i.e. these keys are supported for existence but not matching as per PS 3.4-C.2.2.1.3.

Inquire does not support Relational Queries or combined date and time matching, however when fuzzy-semantic Person Name matching has been successfully negotiated, the Patient Name field will be matched using standard Sybase soundex functionality. The Patient Name field is always treated as case-insensitive. The Specific Character Set attribute (0008,0005) and Timezone Offset from UTC (0008,0201) are ignored and not included in the CFind Results Information Objects.

The values returned for a query may differ to the values present in the related Composite Object as originally received by InDigoX, as the Insignia Database will always return the most up-to-date information as received from the Institution Information System, or as edited using the Insignia System tools.

**Table 4.2-41
Inquire Supported Patient Root & Patient / Study Only PATIENT Level Query Keys**

Name	Tag	Matching Type
Patient Name	(0010,0010)	Single Value, Wild Card, Universal
Patient ID	(0010,0020)	Single Value, Universal
Patient Date of Birth	(0010,0030)	Universal
Patient Sex	(0010,0040)	Universal
Other Patient IDs	(0010,1000)	Universal
Number of Patient Related Studies	(0020,1200)	Universal
Number of Patient Related Series	(0020,1202)	Universal
Number of Patient Related Instances	(0020,1204)	Universal
Retrieve AE Title	(0008,0054)	Inquire AE Title
Instance Availability	(0008,0056)	“ONLINE”

Table 4.2-42
Inquire Supported Patient Root & Patient / Study Only STUDY Level Query Keys

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value, Required
Study Instance UID	(0020,000D)	Single Value, Universal
Study Date	(0008,0020)	Single Value, Range, Universal
Study Time	(0008,0030)	Single Value, Range, Universal
Accession Number	(0008,0050)	Single Value, Wild Card, Universal
Study ID	(0020,0010)	Single Value, Wild Card, Universal
Study Description	(0020,1030)	Universal
Referring Physician	(0008,0090)	Universal
Name of Physician(s) Reading Study	(0008,1060)	Universal
Number of Study Related Series	(0020,1206)	Universal
Number of Study Related Instances	(0020,1208)	Universal
Retrieve AE Title	(0008,0054)	Inquire AE Title
Instance Availability	(0008,0056)	"ONLINE"

Table 4.2-43
Inquire Supported Study Root STUDY Level Query Keys

Name	Tag	Matching Type
Patient Name	(0010,0010)	Single Value, Wild Card, Universal
Patient ID	(0010,0020)	Single Value, Universal
Study Instance UID	(0020,000D)	Single Value, Universal
Study Date	(0008,0020)	Single Value, Range, Universal
Study Time	(0008,0030)	Single Value, Range, Universal
Accession Number	(0008,0050)	Single Value, Wild Card, Universal
Study ID	(0020,0010)	Single Value, Wild Card, Universal
Patient Date of Birth	(0010,0030)	Universal
Patient Sex	(0010,0040)	Universal
Other Patient IDs	(0010,1000)	Universal
Study Description	(0020,1030)	Universal
Referring Physician	(0008,0090)	Universal
Name of Physician(s) Reading Study	(0008,1060)	Universal
Number of Study Related Series	(0020,1206)	Universal
Number of Study Related Instances	(0020,1208)	Universal
Retrieve AE Title	(0008,0054)	Inquire AE Title
Instance Availability	(0008,0056)	"ONLINE"

Table 4.2-44
Inquire Supported Patient Root and Study Root SERIES Level Query Keys

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value Required (If Patient Root)
Study Instance UID	(0020,000D)	Single Value Required
Modality	(0008,0060)	Single Value, Wild Card, Universal
Series Instance UID	(0020,000E)	Single Value, Universal
Series Number	(0020,0011)	Single Value, Universal
Series Description	(0008,103E)	Universal
Series Date	(0008,0021)	Universal
Series Time	(0008,0031)	Universal

Body Part Examined	(0018,0015)	Universal
Performing Physician	(0008,1050)	Universal
Patient Position	(0018,5100)	Universal
Frame Of Reference	(0020,0052)	Universal
Device Model	(0008,1090)	Universal
Manufacturer	(0008,0070)	Universal
Number of Series Related Instances	(0020,1209)	Universal
Retrieve AE Title	(0008,0054)	InQuire AE Title
Instance Availability	(0008,0056)	"ONLINE"

Table 4.2-45
InQuire Supported Patient Root and Study Root IMAGE Level Query Keys

Name	Tag	Matching Type
Patient ID	(0010,0020)	Single Value Required (if Patient Root)
Study Instance UID	(0020,000D)	Single Value Required
Series Instance UID	(0020,000E)	Single Value Required
SOP Instance UID	(0008,0018)	Single Value, Universal
Instance Number	(0020,0013)	Single Value, Universal
SOP Class UID	(0008,0016)	Universal
Content Date	(0008,0023)	Universal
Content Time	(0008,0033)	Universal
Acquisition Date	(0008,0022)	Universal
Acquisition Time	(0008,0032)	Universal
Slice Thickness	(0018,0050)	Universal
Image Type	(0008,0008)	Universal
Retrieve AE Title	(0008,0054)	InQuire AE Title
Instance Availability	(0008,0056)	"ONLINE"

InQuire reserves the right to refuse a query which will generate too many results, for example supplying just a Patient Name as "A*". In particular the Study Date range is limited to 1 month if no other matching fields are supplied. A Study Time Range will be ignored unless a Study Date (Single Value or Range) is supplied. However, if the query is not refused, then all matches will be returned irrespective of number.

A Query request will result in responses with the following status codes:

Table 4.2-46
InQuire Query Response Status Reasons

Service Status	Further Meaning	Error Code	Reasons
Failure	Identifier Does Not Match SOP Class	A900	The Identifier was missing or could not be interpreted as an Information Object for the Query SOP Class at the given level. Error Comment (0000,0902) will be populated with details
	Unable to Process	C000	The Insignia Database query to retrieve the matches failed or was refused. Full details will be logged in the InQuire error log. Error Comment (0000,0902) will be populated with details

Cancelled	Matching terminated due to Cancel Request	FE00	The Cancelled status will be set on the next response returned after receiving the Cancel Request
Success	Matching is complete	0000	All Pending matches have been sent
Pending	Matches are continuing – all requested Optional Keys were supported	FF00	Response contains an Information Object representing the match containing all requested keys
	Matches are continuing – Warning that one or more Optional Keys were not supported for existence for this identifier	FF01	Response contains an Information Object representing the match, but some requested optional keys are not supported - these are logged in the Inquire error log

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**.

4.2.5.4.1.5 SOP Specific Conformance for Retrieve Service Classes

Inquire supports Relational Retrieve – if it is successfully negotiated, only UIDs at the requested Query/Retrieve Level need be supplied, irrespective of the SOP Class used for the request. Inquire supports retrieval of a list of UIDs.

Inquire may generate CStore commands in response to the CMove request for the SOP Classes listed in section **4.2.5.3 'Association Initiation Policy'**. As described in that section, the SOP Instances will be updated as they are sent with the latest Hierarchy and Volatile Demographic information.

If the CStore Association is aborted by the CMove Destination or otherwise unexpectedly terminated, the Query Retrieve association itself will be aborted.

A CMove request will generate Responses with the following statuses:

**Table 4.2-47
Inquire Retrieve Response Status Reasons**

Service Status	Further Meaning	Error Code	Reasons
Failure	Unable to Calculate Matches	A701	The Insignia System could not calculate the set of SOP Instances for the requested hierarchy level, or the set of SOP Instances exist on the Insignia System, but Inquire is unable to retrieve them. Error Comment (0000,0902) will be populated.
	Move Destination Unknown	A801	The current Inquire configuration does not include details of the specified CMove destination
	Identifier Does Not Match SOP Class	A900	The Identifier was missing or could not be interpreted as an Information Object for the Retrieve SOP Class at the given level. Error Comment (0000,0902) will be populated with details

	Unable to Process	C000	The Insignia Database query to retrieve volatile data for the SOP Instances failed, or Inquire failed to initiate a CStore association with the CMove Target, even though it is known. Full details will be logged in the Inquire error log. Error Comment (0000,0902) will be populated.
Cancelled	Matching terminated due to Cancel Request	FE00	The Cancelled status will be set on the next response returned after receiving the Cancel Request
Success	Sub-operations Complete – No Failures	0000	All CStore sub-operations completed with Success or Warning status
Warning	Sub-operations Complete – One or more Failures	B000	All CStore sub-operations completed, some returned Failure status. Failed SOP Instance UID List (0008,0058) will be populated
Pending	Sub-operations are continuing	FF00	CStore sub-operations are progressing, sent at most once every 200ms

The handling of terminal communication errors and normal Association release are detailed in section **4.2.1.3 Association Termination**. If the CMove Association is unexpectedly terminated, the CStore Association will be Aborted.

4.3 Network Interfaces

4.3.1 Physical Network Interface

The Insignia DICOM Application Entities use the WinSock 2 Berkeley Socket API to interact with TCP/IP sockets. As such they are independent of the Physical Network - it is likely within a hospital that the network will be 100baseT or Gigabit Ethernet, but this is not a requirement.

The hardware hosting the Departmental Server node may have multiple network adaptors and IP Addresses, which may be fixed or allocated by DHCP. However, in order to be reachable by the Remote AEs, these IP addresses must be predictable so in the case of DHCP the Departmental Server node will require a permanent address lease. By the nature of Windows Sockets, the Dicom Application Entities will be reachable on their configured ports on all IP Addresses allocated to the node.

4.3.2 Additional Protocols

No particular protocols are used by the Application Entities.

4.3.3 IPv4 and IPv6

The Insignia DICOM Application Entities only support IPv4 addresses.

4.4 Configuration

4.4.1 AE Title / Presentation Address Mapping

4.4.1.1 Local AE Titles

The mapping from Application Entity to AE Title and TCP / IP port is configurable via the Insignia System tools. When a new Departmental Server instance is installed on an Insignia PACS, the Application Entities are pre-allocated default AE Titles and TCP/IP ports as shown in the table below, where the <n> in the AE Titles is a counter, as there may be multiple Departmental Server nodes in the system.

**Table 4.4-1
Default Application Entity Title Configuration**

Application Entity	Default AE Title	Default TCP/IP Port
InList	INLIST<n>	3001
InDigoX	INDIGOX<n>	104
InPort	INPORT<n>	None
InQuire	INQUIRE<n>	3000

4.4.1.2 Remote AE Title / Presentation Address Mapping

The TCP/IP address and port and the set of offered and provided DICOM services for each Remote AE are configurable via the Insignia System Tools.

Each Insignia Application Entity can then be configured to accept / be able to initiate associations with a subset of the configured Remote AEs. For each Insignia / Remote AE Pairing, a subset of the Remote AE's supported Abstract Syntaxes can be selected, along with a subset of Transfer Syntaxes that are known to be compatible.

Only presentation contexts that are configured for a given Insignia AE / Remote AE will be accepted or offered on an association between those two entities.

4.4.2 Parameters

The following table lists parameters that are configurable. Generally this is performed through the Insignia System tools for each Application Entity. Where the MaxPDU sendable is configurable, this is via a registry key for each Application Entity on the Departmental Server.

**Table 4.4-2
Application Entity Configuration**

Parameter	Configurable	Default	Note
General Parameters			
Maximum PDU size receivable	No	Unlimited	Will accept whatever is offered
Timeout waiting for TCP/IP connect() response	No	2500ms	
Timeout waiting for A-ASSOCIATE-RQ PDU after TCP/IP connection opened (ARTIM)	Yes	5000ms	Globally configured per Remote AE
Timeout waiting for response to Association Request	No	Infinite	
Timeout waiting for expected data within a message exchange	No	Infinite	
InList			
Maximum PDU size sendable	No	0	Unlimited
Maximum number of Simultaneous Associations	Yes	5	
Remote AE Titles	Yes		AE Title, IP address, Port
Supported Abstract Syntaxes	Yes		Configured Per Remote AE
Supported Transfer Syntaxes	Yes		Configured Per Remote AE
InDigoX			
Maximum PDU size sendable	Yes	0	Configured via registry key
Maximum number of Simultaneous	Yes	5 Accept	

Associations		1 Request	
Remote AE Titles	Yes		AE Title, IP address, Port
Supported Abstract Syntaxes	Yes		Configured Per Remote AE
Supported Transfer Syntaxes	Yes		Configured Per Remote AE
InPort			
Maximum PDU size sendable	No	0	Unlimited
Maximum number of Simultaneous Associations	Yes	1 Query 5 Retrieve	Number of Retrieve Associations is configurable
CFind Source	Yes		One Remote AE is nominated as the CFind Source
CStore Target	Yes		AE Title of the InDigoX instance
Remote AE Titles	Yes		AE Title, IP address, Port
Supported Abstract Syntaxes	Yes		Configured Per Remote AE
Supported Transfer Syntaxes	Yes		Configured Per Remote AE
InQuire			
Maximum PDU size sendable	Yes	0	Configured via registry key
Maximum number of Simultaneous Associations	Yes	5 Accept 5 Request	5 Query / Retrieve Associations, 5 resultant Storage Associations
Maximum number of simultaneous unsolicited routing Associations	Yes	10	
Remote AE Titles	Yes		AE Title, IP address, Port
Supported Abstract Syntaxes	Yes		Configured Per Remote AE
Supported Transfer Syntaxes	Yes		Configured Per Remote AE

5 Media Interchange

The Insignia DICOM Application Entities specified in this document do not support Media Interchange.

6 Support of Character Sets

The Insignia DICOM Application Entities specified in this document do not currently have any specific support for Character Sets other than the Default Character Repertoire. If a Character Set is specified in a received SOP Instance it will be preserved and forwarded by the Retrieve service, the data registered with the Insignia Database will be interpreted as if it were from the Default Character Repertoire. If a Character Set is specified in a Query, the characters will be interpreted as if they were from the Default Character Repertoire – if the query specifies the same Character Set as an original SOP Instance, the database query will then match the original data, though the Query Response will not specify the Character Set in the result.

7 Security

7.1 Security Profiles

Security Profiles are not supported.

7.2 Association Level Security

Each Application Entity which listens on its configured TCP/IP Port for an incoming network connection (InList, InDigoX and InQuire) has a configured list of remote Application Entities, together with their IP addresses, from which it may accept connections. If a connection is detected from an IP address not in the configured list, the first Association Request will result in the Association being Rejected with the reason "Calling AE Title Not Recognized", and a message being logged with the Insignia database. Subsequent connections from that IP address will result in the socket being closed immediately with no attempt at association negotiation.

If the connection is from an IP address which hosts known Remote AEs, but the Calling AE Title in the Association Request does not match an AE Title configured for that IP Address, the Association will be rejected with the reason "Calling AE Title Not Recognized", even if the AE Title is known on a different IP Address.

7.3 Application Level Security

The DICOM Application Entities are implemented as Windows Services. As such they have no direct User interaction, so further direct User related security is not required. Where User input is utilised indirectly it is via data input through other application User Interfaces to the Database. Each of these Applications has its own user authentication methods outside the scope of this document, and all user input is filtered, validated and encoded by those applications before it is passed to the Database for use by the Application Entities detailed in this document.

8 Annexes

8.1 IOD Contents

8.1.1 Created SOP Instances

The Insignia DICOM Application Entities detailed in this document do not create SOP Instances.

8.1.2 Usage of Attributes from received IODs

When SOP Instances are received by InDigoX, the source Application Entity and values of certain attributes are registered with the Insignia Database if they are present in the SOP Instance, to allow other Applications in the Insignia System to access the data without parsing the Stored DICOM Objects. These are as follows:

Table 8.1-1
Attributes Registered with Insignia Database on SOP Instance Receipt

Attribute Name	Tag	Notes
Patient IOD		
Patient Name	(0010,0010)	
Patient ID	(0010,0020)	Required
Patient Date of Birth	(0010,0030)	
Patient Sex	(0010,0040)	
General Study IOD		
Study Instance UID	(0020,000D)	Required
Study ID	(0020,0010)	
Study Description	(0008,1030)	
Study Date	(0008,0020)	
Study Time	(0008,0030)	
Referring Physician Name	(0008,0090)	
Accession Number	(0008,0050)	
Equipment IOD		
Manufacturer	(0008,0070)	
Manufacturer Model Name	(0008,1090)	
General Series IOD		
Series Instance UID	(0020,000E)	Required
Modality	(0008,0060)	
Performing Physicians' Names	(0008,1050)	First Value Only
Body Part Examined	(0018,0015)	
Series Number	(0020,0011)	
Series Description	(0008,103E)	
Patient Position	(0018,5100)	
Series Date	(0008,0021)	
Series Time	(0008,0031)	
Laterality	(0020,0060)	(0020,0062) if present in Specialised Image Module
General Image IOD		
Image Type	(0008,0008)	First 3 values recorded
Acquisition Date	(0008,0022)	
Acquisition Time	(0008,0032)	
Content Date	(0008,0023)	
Content Time	(0008,0033)	
Instance Number	(0020,0013)	

Reference Image Sequence	(0008,1140)	Required for Presentation State SOP Classes
> Reference SOP Instance	(0008,1155)	
SOP Common		
SOP Class UID	(0008,0016)	
SOP Instance UID	(0008,0018)	
Multiframe IOD		
Number of Frames	(0028,0008)	
Frame of Reference IOD		
Frame of Reference UID	(0020,0052)	
Image Pixel IOD		
Bits Stored	(0028,0101)	Required if Pixel Data Present
Signed Data	(0028,0103)	Required if Pixel Data Present
Rows	(0028,0010)	
Columns	(0028,0011)	
Pixel Data	(07FE,0010)	Required for Image Storage SOP Classes
Image Plane IOD		
Image Orientation	(0020,0037)	
Image Position	(0020,0032)	
Slice Thickness	(0018,0050)	
Slice Location	(0020,1041)	
Pixel Spacing	(0028,0030)	Will use Imager Pixel Spacing (0018,1164) if not present
Modality LUT IOD		
Rescale Intercept	(0028,1052)	
Rescale Slope	(0028,1053)	
VOI LUT IOD		
Window Centre	(0028,1050)	Only first value is recorded in Database
Window Width	(0028,1051)	Only first value is recorded in Database
Cine IOD		
Cine Rate	(0018,0040)	
DX / MG Modules		
View Position	(0018,5101)	Will use Code in View Code Sequence (0054,0220) in preference if present in Specialised Image Module
MR Image Module		
Temporal Position Identifier	(0020,0100)	
Number of Temporal Positions	(0020,0105)	

8.1.3 Attribute Mapping

The Insignia System is highly configurable when mapping Real World information to values received in SOP Instances and from information received over an HL7 (or other) data feed. The Data Feed is configured to take items from various places in the HL7 (or other) protocol and map these to Insignia Database fields representing Real World Hierarchy Levels such as Visit, Admission, Requested Procedure, Scheduled Procedure Step etc.

Each Remote Application Entity which can perform Worklist Queries has its own section of configuration in the Insignia System which specifies how the Real World information is then mapped to various DICOM Attributes for the CFind Request and Responses. In particular the usage of Study ID and Accession Number is configurable.

Each Remote Application Entity which can generate and send SOP Instances to InDigoX also has individual configuration on the Insignia System which specifies where that modality will place the pieces of Real World information so that they can be correctly mapped from the fields passed to the Insignia Database as detailed in **Table 8.1-1**. This same mapping is used when updating volatile information when sending SOP Instances back to Remote Application Entities via Inquire to ensure that the Real World information is conveyed in the expected DICOM Attributes for the given target Application Entity.

8.1.4 Coerced / Modified fields

When SOP Instances are sent by Inquire, certain fields may be different to those as they were received by InDigoX. The changes will be in response to altered hierarchy and real-world information as received by the System Information Feed (from the Institution RIS or otherwise), or as entered by Administrative Users via the Insignia System tools. When such changes occur they are logged in the Insignia System.

**Table 8.1-2
Fields Updated**

Field	Tag
Patient Name	(0010,0010)
Patient ID	(0010,0020)
Patient Date of Birth	(0010,0030)
Patient Sex	(0010,0040)
Other Patient ID	(0010,1000)
Study Instance UID	(0020,000D)
Study ID	(0020,0010)
Study Date	(0008,0020)
Study Time	(0008,0030)
Accession Number	(0008,0050)
Referring Physician Name	(0008,0090)
Study Description	(0008,1030)
Procedure Code Sequence	(0008,1032)
> Code Value	(0008,0100)
> Code Meaning	(0008,0104)
> Coding Scheme Designator	(0008,0102)
> Coding Scheme Version	(0008,0103)
Physician of Record Names	(0008,1048)
Performing Physician Name	(0008,1050)
Reading Physician Names	(0008,1060)
Series Instance UID	(0020,000E)
Body Part Examined	(0018,0015)
SOP Instance UID	(0008,0018)

8.2 Data Dictionary of Private Attributes

The Insignia DICOM Application Entities detailed in this document do not generate any Private Attributes

8.3 Coded Terminology and Templates

8.3.1 Private Code Definitions

The Insignia System receives Requested Procedure and Scheduled Procedure Step Codes from the Institution Information System data feed. Often this data feed does not contain a meaning for the Code, so the Insignia Database has reference data to supply a Code Meaning for each Code Value used by the Institution. When generating responses to Modality Worklist Queries, it is the Code Value received from the Information feed along with the configured Code Meaning that are passed on to the requesting Application Entity in the Requested Procedure Code and Scheduled Procedure Code Sequence fields of the query responses. The Insignia System has a configuration item to record the Designator of the codes used by an Institution which will be used if known; otherwise the Coding Scheme Designator will be given as "INSIGNIA PRIVATE".