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DICOM Conformance Statement

Native DICOM

Version 1.0.1

Applicable to:

- NZAcquire (RUO) Version 3.3.0

2026-06-10

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1 CONFORMANCE STATEMENT OVERVIEW

The software package Native DICOM is used in anatomic digital pathology to support the image acquisition (scanning) process of a Hamamatsu digital slide scanner by storing the scanned images in a format that is compliant with the DICOM Standard for Whole Slide Imaging (WSI). The software package is used, e.g., for NZAcquire (Research Use Only).

Native DICOM supports various DICOM services, using the OFFIS DICOM Toolkit (DCMTK), to provide the following capabilities:

- Sending DICOM Whole Slide Microscopy Images obtained from anatomic pathology slides to a DICOM-compliant archive.
- Requesting the DICOM-compliant archive to take responsibility for the safekeeping of the previously transferred DICOM images.

Table 1-1 provides an overview of the network services supported by Native DICOM. Media services are not supported.

Table 1-1
NETWORK SERVICES

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
VL Whole Slide Microscopy Image Storage	Yes	No
Workflow Management		
Storage Commitment Push Model	Yes	No

When used with NZAcquire, the network services are provided by NZDicom, if available, i.e., NZAcquire itself does not support any DICOM network services.

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3 INTRODUCTION

This DICOM Conformance Statement specifies the behavior and functionality of the Native DICOM software package with regard to supported DICOM networking SOP Classes and created SOP Instances. Native DICOM is used in anatomic digital pathology to support the image acquisition (scanning) process of a Hamamatsu digital slide scanner by storing the scanned images in a format that is compliant with the DICOM Standard for Whole Slide Imaging (WSI).

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3.1 Revision History

Document Version	Date of Issue	Author	Description
Version 1.0.0	2026-03-24	Jörg Riesmeier, Richard Preston, Jeremy Cooke, Kade Rashid	Initial release.
Version 1.0.1	2026-06-10	Richard Preston	Add section 4.5 Viewers, adapted for Research Use Only versions

3.2 Audience

This document is written for the people that need to understand how Native DICOM will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. This document contains some basic DICOM definitions so that any reader may understand how this product implements DICOM features. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's 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 Native DICOM 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. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, 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 the product 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 [DICOM] 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, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.

Application Entity Title (AET): 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. Example: 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 specified set of Attributes that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The Attributes may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and 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.

Joint Photographic Experts Group (JPEG): A set of standardized image compression techniques, available for use by DICOM applications.

Media Application Profile: The specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs).

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 (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.

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). Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).

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 Class (SOP Class): The specification of the network or media 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 Instance (SOP Instance): An information object; a specific occurrence of information exchanged in a SOP Class. 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 format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (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 DICOM protocol must first agree on several things during an initial network "handshake". One of the two devices must initiate an *Association* (a connection to the other device), and ask if specific services, information, and encoding can be supported by the other device (*Negotiation*).

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 exchanging 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.

Two Application Entities may also communicate with each other by exchanging media (such as a CD-R). Since there is no Association Negotiation possible, they both use a *Media Application Profile* that specifies “pre-negotiated” exchange media format, Abstract Syntax, and Transfer Syntax.

3.6 Abbreviations

The following list illustrates all abbreviations that are used in this document.

ACSE	Association Control Service Element
AE	Application Entity
CD	Compact Disk
CDA	Clinical Document Architecture
CD-R	Compact Disk Recordable
CT	Computed Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
HL7	Health Level Seven
ICC	International Color Consortium
ID	Identifier
IOD	Information Object Definition
IP	Internet Protocol
IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group
LIMS	Laboratory Information Management System
MR	Magnetic Resonance
NEMA	National Electrical Manufacturers Association
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
SR	Structured Reporting
TCP/IP	Transmission Control Protocol / Internet Protocol
UCS	Universal Character Set
UID	Unique Identifier
UTF	UCS Transformation Format
VL	Visible Light
VM	Value Multiplicity
VR	Value Representation
WSI	Whole Slide Imaging

3.7 References

[DICOM] NEMA PS3 / ISO 12052 Digital Imaging and Communications in Medicine (DICOM) Standard, National Electrical Manufacturers Association, Rosslyn, VA, USA (available free at https://www.dicomstandard.org/)

[NZDicom] DICOM Conformance Statement of NZDicom Version 1.3.1, Hamamatsu Photonics K.K., Hamamatsu City, Japan

4 NETWORKING

4.1 Implementation Model

4.1.1 Application Data Flow

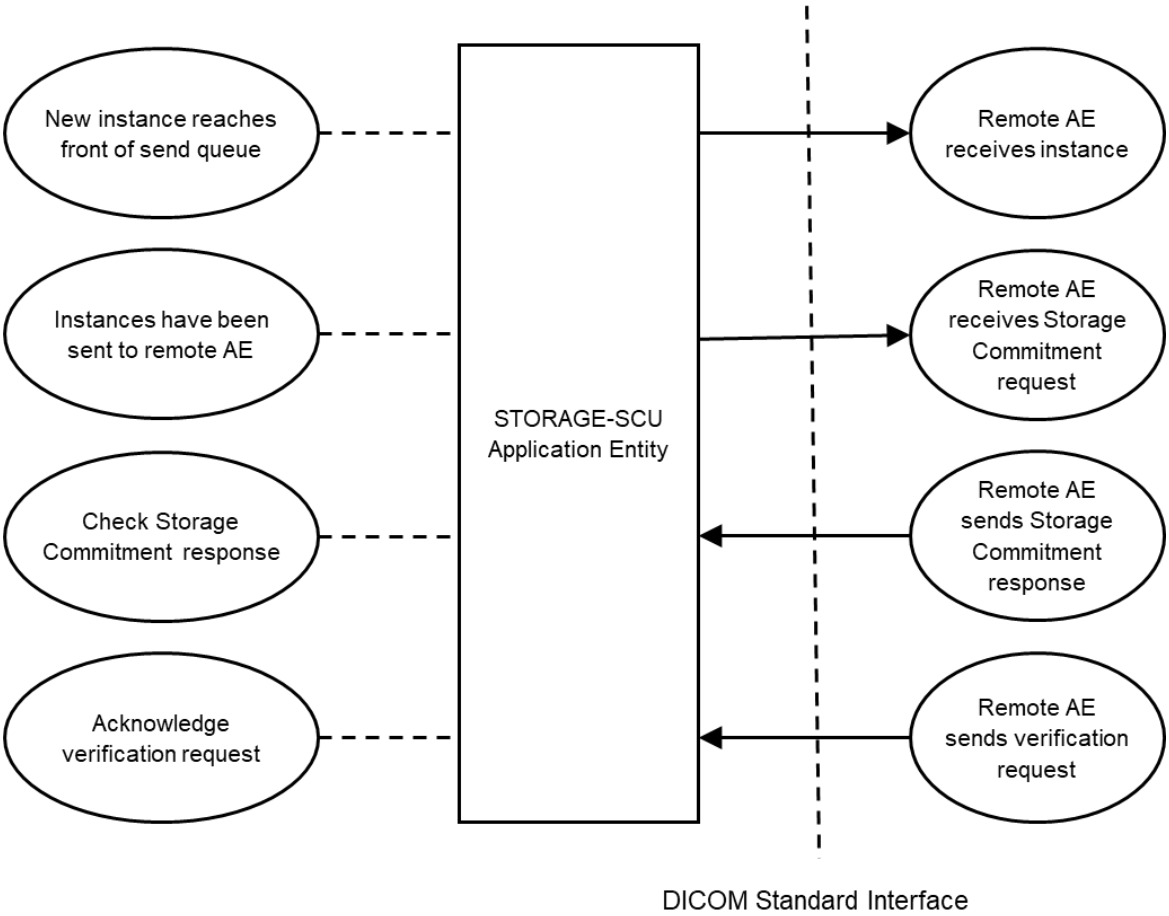


Figure 4-1. Application Data Flow Diagram

Conceptually, the networking services that are implemented by Native DICOM may be modeled as a single Application Entity (AE) as show in Figure 4-1.

4.1.2 Functional Definitions of AEs

4.1.2.1 STORAGE-SCU

The STORAGE-SCU is activated when the user has enabled the use of C-STORE in the Native DICOM configuration settings. When a slide has been scanned and (optionally) quality checked, it is added to the send queue. The STORAGE-SCU is then automatically initiated when a DICOM object (stored as a file) reaches the front of the send queue. A new connection to the pre-configured server (remote AE) is established to initiate the sending process.

If the use of Storage Commitment is also enabled in the Native DICOM configuration settings, a Storage Commitment request is sent to confirm that the previously transferred DICOM objects have been stored persistently. For each request, a new connection is established to the server (remote AE) that is configured for this service.

4.1.3 Sequencing of Real-World Activities

Each time a new slide is scanned, the image is stored as a DICOM WSI object and then added to the send queue (if C-STORE is enabled). Depending on the configuration settings, only one or multiple Associations can be started at the same time, i.e., in parallel, each of them transferring a single DICOM object.

Independently of this, if the use of Storage Commitment is enabled and Storage Commitment has not been requested for at least one of the DICOM objects transferred successfully, a Storage Commitment request is sent with the SOP Instance UID of the respective DICOM object. Depending on the configuration settings, one or more SOP Instances are listed in the Storage Commitment request, requesting to confirm the persistent storage of the related DICOM objects. The remaining SOP Instances are handled in separate Associations and Storage Commitment requests.

Table 4-2 illustrates the above-described sequencing of real-world activities for the simple case, i.e., without any parallel activities. It also does not show the combination of NZAcquire and NZDicom.

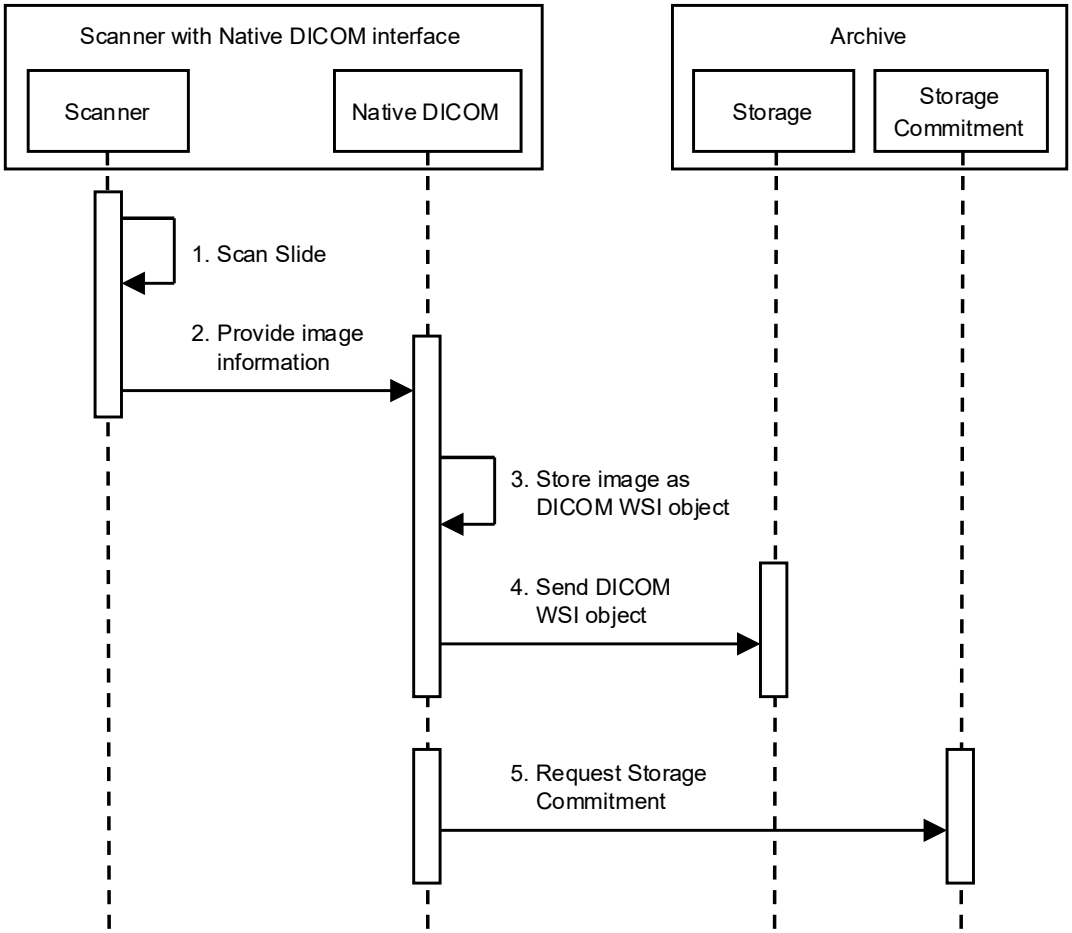


Figure 4-2. Sequencing of Real-World Activities Diagram

4.2 AE Specifications

4.2.1 STORAGE-SCU

4.2.1.1 SOP Classes

The STORAGE-SCU provides Standard Conformance to the following DICOM SOP Classes.

Table 4-1
SOP CLASSES FOR AE STORAGE-SCU

SOP Class Name	SOP Class UID	SCU	SCP
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No

4.2.1.2 Association Policies

4.2.1.2.1 General

The STORAGE-SCU usually initiates Associations. However, if the use of Storage Commitment is enabled, the STORAGE-SCU also accepts Associations.

The DICOM Application Context Name, which is listed in the following table, is always proposed and accepted:

Table 4-2
DICOM APPLICATION CONTEXT

Application Context Name	1.2.840.10008.3.1.1.1

4.2.1.2.2 Number of Associations

Table 4-3
NUMBER OF ASSOCIATIONS AS AN ASSOCIATION INITIATOR FOR AE STORAGE-SCU

Maximum number of simultaneous Associations	Depends on configuration (see Section 4.4.2)

Table 4-4
NUMBER OF ASSOCIATIONS AS AN ASSOCIATION ACCEPTOR FOR AE STORAGE-SCU

Maximum number of simultaneous Associations	1

The STORAGE-SCU only accepts Associations if the use of Storage Commitment is enabled.

4.2.1.2.3 Asynchronous Nature

Asynchronous mode of operation is not supported.

4.2.1.2.4 Implementation Identifying Information

Table 4-5
DICOM IMPLEMENTATION CLASS AND VERSION FOR AE STORAGE-SCU

Implementation Class UID	1.2.276.0.7230010.3.0.3.6.9
Implementation Version Name	OFFIS_DCMTK_369

4.2.1.3 Association Initiation Policy

The STORAGE-SCU automatically attempts to initiate a new Association each time a DICOM object reaches the front of the send queue. It also initiates a new Association if instances have been sent successfully to the remote AE and Storage Commitment is enabled.

4.2.1.3.1 Activity – New instance reaches front of send queue

4.2.1.3.1.1 Description and Sequencing of Activities

The STORAGE-SCU sends the first DICOM object in the send queue to the remote AE (C-STORE). For each instance to be transferred, a new Association is initiated. Depending on the configuration

settings, multiple Associations may be started at the same time, i.e., in parallel. If the transmission fails, Native DICOM can perform retry attempts according to the configuration settings (see Section 4.4.2). On each failed attempt, an error message will be displayed on the user interface and reported to a log file.

Figure 4-3 illustrates the above-described sequencing of activities for a single Association.

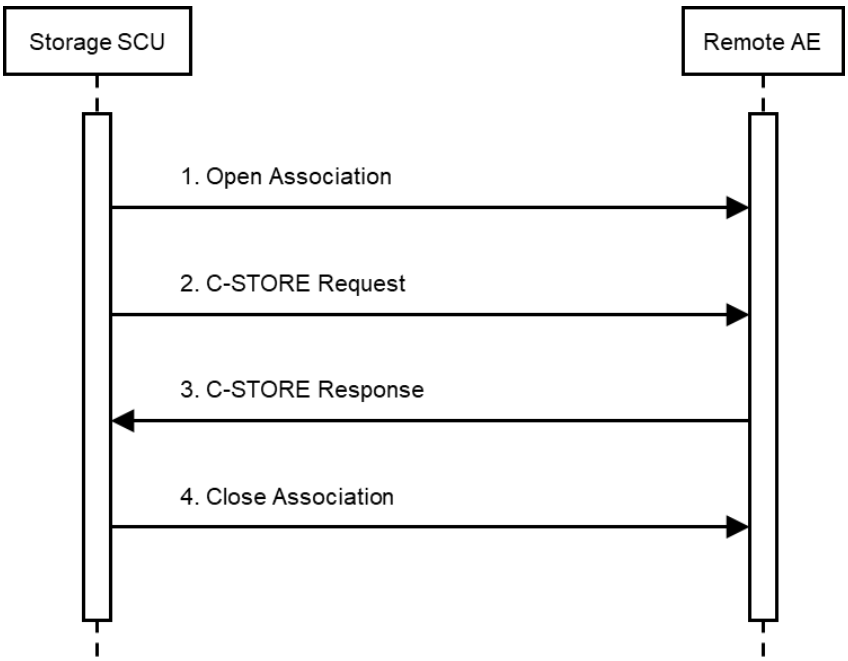


Figure 4-3. Sequencing of Activity “New instance reaches front of send queue”

4.2.1.3.1.2 Proposed Presentation Contexts

Table 4-6

PROPOSED PRESENTATION CONTEXTS FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY ‘NEW INSTANCE REACHES FRONT OF SEND QUEUE’

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6	JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50	SCU	None

4.2.1.3.1.2.1 Extended Negotiation

No Extended Negotiation is performed.

4.2.1.3.1.2.2 Presentation Context Acceptance Criterion

The STORAGE-SCU does not accept Associations (for this real-world activity).

4.2.1.3.1.2.3 Transfer Syntax Selection Policies

Since the STORAGE-SCU proposes a single Presentation Context only, the remote AE (SCP) is responsible for the Transfer Syntax selection.

4.2.1.3.1.3 SOP Specific Conformance

4.2.1.3.1.3.1 SOP Specific Conformance to Storage SOP Classes

The STORAGE-SCU provides Standard Conformance to the Storage Service Class as an SCU. It only supports the VL Whole Slide Microscopy Image Storage SOP Class.

After a successful transmission, if Storage Commitment is not enabled, the DICOM file is left as-is or moved to another folder and/or deleted after a specific period of time, depending on the configuration. If transmission failed, the DICOM file is left as-is or moved to another folder, after all retry attempts have failed.

The STORAGE-SCU will behave as described in the table below when receiving the C-STORE response command message.

Table 4-7
RESPONSE STATUS HANDLING BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'NEW INSTANCE REACHES FRONT OF SEND QUEUE'

Service Status	Further Meaning	Error Code	Behavior
Failure	Refused: Out of resources	A7xx	This is treated as a permanent failure. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
	Refused: SOP Class not supported	0122	This is treated as a permanent failure. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
	Error: Data Set does not match SOP Class	A9xx	This is treated as a permanent failure. An error message is displayed on the user interface and the entire storage process for this retry attempt is stopped. Details are reported to a log file that is available to administrators.
	Error: Cannot understand	Cxxx	This is treated as a permanent failure. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Warning		Bxxx	Transmission of the DICOM instance is considered successful. A message about the success is displayed on the user interface. Details are reported to a log file that is available to administrators.
Success		0000	The DICOM instance was successfully received by the remote AE. A message about the success is displayed on the user interface. Details are reported to a log file that is available to administrators.
		Any other status code	The remote AE returned an unknown status code. This is treated as an error. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

Table 4-8
COMMUNICATION FAILURE BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'NEW INSTANCE REACHES FRONT OF SEND QUEUE'

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Data could not be sent or received on a network socket within the specified time range.	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
ACSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Association aborted by the SCP using A-ABORT or the network layers indicate communication loss (i.e., low-level TCP/IP socket closure)	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

4.2.1.3.2 Activity – Instances have been sent to remote AE

4.2.1.3.2.1 Description and Sequencing of Activities

If the STORAGE-SCU has sent one or more DICOM objects successfully to the remote AE and the use of Storage Commitment is enabled, the STORAGE-SCU sends a Storage Commitment request (N-ACTION) to confirm that the previously transferred DICOM objects have been stored persistently. Depending on the configuration, a new Association is initiated either for each DICOM object or for multiple DICOM objects. After a pre-configured timeout has elapsed without receiving the response to the Storage Commitment request (N-EVENT-REPORT), the current Association is released.

As the STORAGE-SCU also listens on a configurable TCP/IP port for incoming connection requests, the STORAGE-SCU is able to receive the Storage Commitment response at a later time, i.e., on a separate Association (see Section 4.2.1.4.1).

If the request fails, Native DICOM can perform retry attempts according to the configuration settings. On each failed attempt, an internal error counter will be increased. Details will be reported to a log file.

Figure 4-4 illustrates the above-described sequencing of activities (in case the timeout did not elapse).

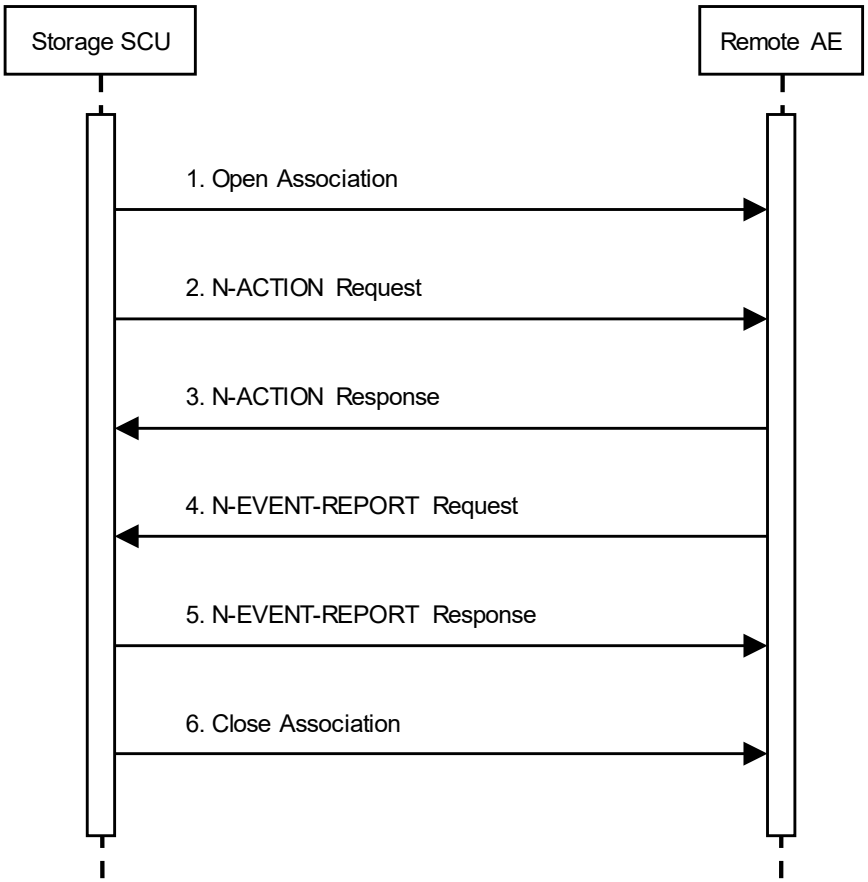


Figure 4-4. Sequencing of Activity “Instances have been sent to remote AE”

4.2.1.3.2.2 Proposed Presentation Contexts

Table 4-9

PROPOSED PRESENTATION CONTEXTS FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY ‘INSTANCES HAVE BEEN SENT TO REMOTE AE’

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008 .1.20.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2	SCU	None

4.2.1.3.2.2.1 Extended Negotiation

No Extended Negotiation is performed.

4.2.1.3.2.2.2 Presentation Context Acceptance Criterion

The STORAGE-SCU does not accept Associations (for this real-world activity).

4.2.1.3.2.2.3 Transfer Syntax Selection Policies

Since the STORAGE-SCU proposes a single Presentation Context only, the remote AE (SCP) is responsible for the Transfer Syntax selection.

4.2.1.3.2.3 SOP Specific Conformance

4.2.1.3.2.3.1 SOP Specific Conformance for Storage Commitment SOP Class

The STORAGE-SCU provides Standard Conformance to the Storage Commitment Push Model SOP Class as an SCU. It only requests Storage Commitment for instances of the VL Whole Slide Microscopy Image Storage SOP Class. The STORAGE-SCU provides a value for Transaction UID in the request, but does not check the value provided by the SCP in the response. The STORAGE-SCU does not send the optional Attributes Storage Media File-Set ID and Storage Media File-Set UID in the N-ACTION request.

The STORAGE-SCU will consider Storage Commitment successful if an N-EVENT-REPORT request is received with a value of 1 for Event Type ID. Depending on the configuration settings, the DICOM file, for which Storage Commitment has been requested and which was successful, is left as-is or moved to another folder and/or deleted after a specific period of time. If the value of Event Type ID is 2, i.e., failures exist, the DICOM file is left as-is or moved to another folder, after all retry attempts have failed.

The STORAGE-SCU will behave as described in the table below when receiving the N-ACTION response or the N-EVENT-REPORT request command message.

Table 4-10
RESPONSE STATUS HANDLING BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'INSTANCES HAVE BEEN SENT TO REMOTE AE'

Service Status	Further Meaning	Error Code	Behavior
Success		0000	N-ACTION: The Storage Commitment request is considered successfully sent to the remote AE. A timer is started that will expire if no N-EVENT-REPORT request is received within a configurable timeout period. N-EVENT-REPORT: The Storage Commitment result has been received successfully. The attached dataset is evaluated in order to check whether the persistent storage of the previously transferred DICOM objects has been confirmed or whether failures exist. A message about the success (or failure) is displayed on the user interface. Details are reported to a log file that is available to administrators.
		Any other status code	This is treated as a permanent failure. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

Table 4-11
COMMUNICATION FAILURE BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'INSTANCES HAVE BEEN SENT TO REMOTE AE'

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Data could not be sent or received on a network socket within the specified time range.	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

ACSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Association aborted by the SCP using A-ABORT or the network layers indicate communication loss (i.e., low-level TCP/IP socket closure)	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

4.2.1.4 Association Acceptance Policy

The STORAGE-SCU accepts Associations if the use of Storage Commitment is enabled, a TCP/IP port is configured to listen on and Native DICOM is in “Run” mode. When the STORAGE-SCU receives an Association request from a remote AE, it accepts any Association for which at least one Presentation Context is accepted. The Calling and Called Application Entity Titles are ignored. The responding AE Title will always be identical to the Called AE Title that was specified by the remote AE.

Association requests may be rejected with the following status codes and reasons.

Table 4-12
ASSOCIATION REJECTION REASONS

Result	Source	Reason	Description
2 – Rejected transient	1 – Service User	2 – Application context name not supported	Incorrect application context name
1 – Rejected permanent	1 – Service User	1 – No reason given	Some other error

4.2.1.4.1 Activity – Remote AE sends Storage Commitment response

4.2.1.4.1.1 Description and Sequencing of Activities

If the use of Storage Commitment is enabled and a pre-configured timeout elapsed before the Storage Commitment response has been received on the current Association, the STORAGE-SCU receives the expected Storage Commitment response (N-EVENT-REPORT) on a separate Association. For this reason, the STORAGE-SCU listens on a configurable TCP/IP port for incoming connection requests.

Figure 4-5 illustrates the above-described sequencing of activities.

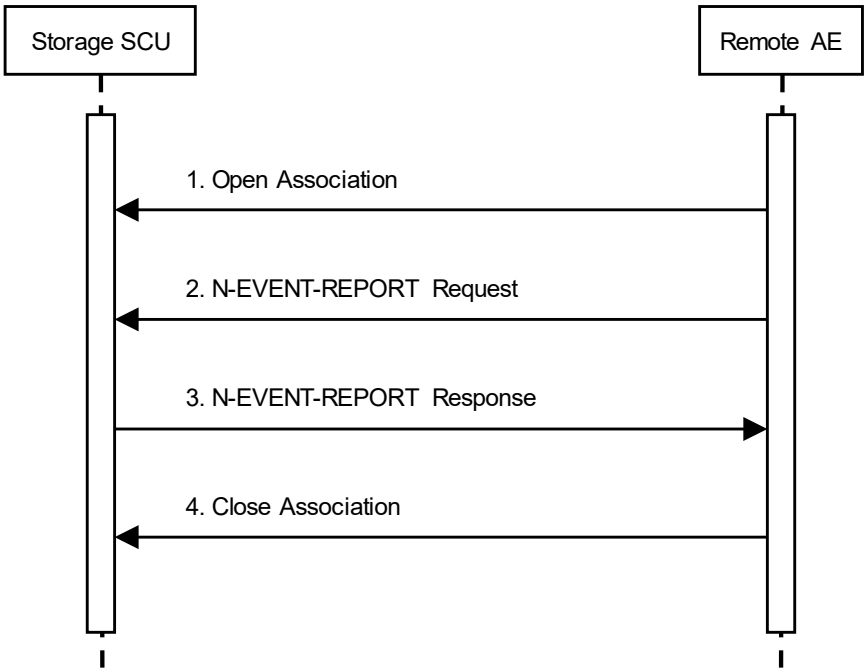


Figure 4-5. Sequencing of Activity “Remote AE sends Storage Commitment response”

4.2.1.4.1.2 Accepted Presentation Contexts

Table 4-13

ACCEPTABLE PRESENTATION CONTEXTS FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY ‘REMOTE AE SENDS STORAGE COMMITMENT RESPONSE’

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2	SCU	None

4.2.1.4.1.2.1 Extended Negotiation

No Extended Negotiation is performed.

4.2.1.4.1.2.2 Presentation Context Acceptance Criterion

The STORAGE-SCU will accept all Presentation Contexts that contain one of the supported SOP Classes and one of the supported Transfer Syntaxes.

4.2.1.4.1.2.3 Transfer Syntax Selection Policies

If multiple Transfer Syntaxes are proposed for one of the supported SOP Classes, the STORAGE-SCU will prefer to select the Explicit VR Little Endian Transfer Syntax. The STORAGE-SCU will only accept the SCU role (which must be proposed via SCP/SCU Role Selection Negotiation) within a Presentation Context for the Storage Commitment Push Model SOP Class.

4.2.1.4.1.3 SOP Specific Conformance

4.2.1.4.1.3.1 SOP Specific Conformance for Storage Commitment Push Model SOP Class

The STORAGE-SCU provides Standard Conformance to the Storage Commitment Push Model SOP Class as an SCU. However, the STORAGE-SCU does not check the value for Transaction UID provided

by the SCP in the response.

The STORAGE-SCU will consider Storage Commitment successful if an N-EVENT-REPORT request is received with a value of 1 for Event Type ID. Depending on the configuration settings, the DICOM file, for which Storage Commitment has been requested and which was successful, is left as-is or moved to another folder and/or deleted after a specific period of time. If the value of Event Type ID is 2, i.e., failures exist, the DICOM file is left as-is or moved to another folder, after all retry attempts have failed.

The STORAGE-SCU will behave as described in the table below when receiving the N-EVENT-REPORT request command message.

Table 4-14
RESPONSE STATUS HANDLING BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'REMOTE AE SENDS STORAGE COMMITMENT RESPONSE'

Service Status	Further Meaning	Error Code	Behavior
Success		0000	The Storage Commitment result has been received successfully. The attached dataset is evaluated in order to check whether the persistent storage of the previously transferred DICOM object has been confirmed or whether failures exist. A message about the success (or failure) is displayed on the user interface. Details are reported to a log file that is available to administrators.
		Any other status code	This is treated as a permanent failure. An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

Table 4-15
COMMUNICATION FAILURE BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'REMOTE AE SENDS STORAGE COMMITMENT RESPONSE'

Exception	Behavior
Data could not be sent or received on a network socket within the specified time range.	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
ACSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Association aborted by the SCU using A-ABORT or the network layers indicate communication loss (i.e., low-level TCP/IP socket closure)	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

4.2.1.4.2 Activity – Remote AE sends verification request

4.2.1.4.2.1 Description and Sequencing of Activities

The STORAGE-SCU Application Entity acknowledges receipt of the verification request while the SCP process is running, i.e., when the STORAGE-SCU is configured to listen on a TCP/IP port for incoming connection requests.

Figure 4-6 illustrates the sequencing of activities, assuming that a new Association is initiated by the remote AE each time this activity is used.

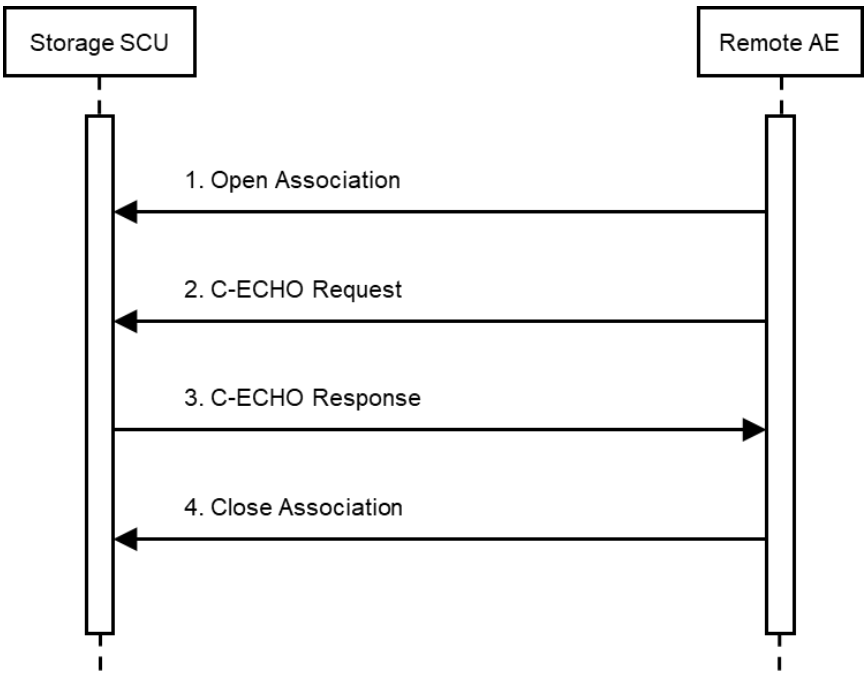


Figure 4-6. Sequencing of Activity “Remote AE sends verification request”

4.2.1.4.2.1 Accepted Presentation Contexts

Table 4-16
ACCEPTABLE PRESENTATION CONTEXTS FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY ‘REMOTE AE SENDS VERIFICATION REQUEST’

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2	SCP	None

4.2.1.4.2.1.1 Extended Negotiation

No Extended Negotiation is performed.

4.2.1.4.2.1.2 Presentation Context Acceptance Criterion

The STORAGE-SCU will accept all Presentation Contexts that contain one of the supported SOP Classes and one of the supported Transfer Syntaxes.

4.2.1.4.2.1.3 Transfer Syntax Selection Policies

If multiple Transfer Syntaxes are proposed for one of the supported SOP Classes, the STORAGE-SCU will prefer to select the Explicit VR Little Endian Transfer Syntax.

4.2.1.4.2.2 SOP Specific Conformance

4.2.1.4.2.2.1 SOP Specific Conformance for Verification SOP Class

The STORAGE-SCU provides Standard Conformance to the Verification SOP Class as an SCP.

The STORAGE-SCU will behave as described in the table below when receiving the C-ECHO request command message.

Table 4-17
RESPONSE STATUS RETURN REASONS FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'REMOTE AE SENDS VERIFICATION REQUEST'

Service Status	Further Meaning	Error Code	Reason
Success		0000	The C-ECHO request is accepted. The STORAGE-SCU is waiting for the next connection request.

Table 4-18
COMMUNICATION FAILURE BEHAVIOR FOR AE STORAGE-SCU AND REAL-WORLD ACTIVITY 'REMOTE AE SENDS VERIFICATION REQUEST'

Exception	Behavior
Data could not be sent or received on a network socket within the specified time range.	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
ACSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.
Association aborted by the SCU using A-ABORT or the network layers indicate communication loss (i.e., low-level TCP/IP socket closure)	An error message is displayed on the user interface. Details are reported to a log file that is available to administrators.

4.3 Network Interfaces

4.3.1 Physical Network Interface

The DICOM applications of Native DICOM are indifferent to the physical medium over which TCP/IP is used.

4.3.2 Additional Protocols

When host names rather than IP addresses are used in the configuration to specify presentation addresses for remote AEs, the application is dependent on the name resolution mechanism of the underlying operating system.

4.3.3 IPv4 and IPv6 Support

Native DICOM only supports IPv4 connections.

4.4 Configuration

4.4.1 AE Title / Presentation Address Mapping

The Calling AE Title of the local AEs is configurable. The mapping of the logical name by which remote AEs are described in the user interface to Called AE Title as well as presentation address (hostname or IP address and port number) is configurable, too.

4.4.1.1 Local AE Titles

Table 4-19
AE TITLE CONFIGURATION TABLE

Application Entity	Default AE Title	Default TCP/IP Port
STORAGE-SCU	–	–

Local AE Titles may be configured by service personnel. For the optional Storage Commitment service, also the TCP/IP port for incoming connections (“Receive Port”) can be configured.

4.4.1.2 Remote AE Titles

The AE Title, host name or IP address and port number of the remote AE can be configured by service personnel, each of them separately for Transmission (C-STORE) and Storage Commitment.

4.4.2 Configurable Parameters

Native DICOM allows for configuring a number of parameters. The following table lists only those configuration parameters that are relevant for DICOM communication.

Table 4-20
CONFIGURABLE PARAMETERS

Parameter	Configurable	Default Value
General Parameters		
Time-out waiting for response to TCP/IP connection request	Yes	5 seconds
Time-out for network socket	No	60 seconds
Time-out for ACSE messages	Yes	5 seconds
Time-out for DIMSE messages	Yes	5 seconds
Maximum PDU size the AE can receive	No	16,384 bytes
STORAGE-SCU Parameters (Transmission)		
Folder where to look for DICOM objects to be transmitted	Yes	–
Option to look into sub-folders of the above folder	Yes	Off
Number of retry attempts (in case of Transmission error)	Yes	1
Delay for retry attempts (in case of Transmission error)	Yes	1 second
Number of simultaneous Associations (outgoing network connections)	Yes	1
Folder where DICOM objects should be moved if Transmission succeeded	Yes	–
Time span for deleting successfully transmitted, and optionally moved, DICOM objects	Yes	Never
Folder where DICOM objects should be moved if Transmission fails	Yes	–

STORAGE-SCU Parameters (Storage Commitment)		
Option to enable use of Storage Commitment	Yes	Off
Number of retry attempts (in case of Storage Commitment error)	Yes	10,000
Delay for retry attempts (in case of Storage Commitment error)	Yes	60 seconds
Number of DICOM objects for which Storage Commitment is requested	Yes	100
Time-out to wait for incoming N-EVENT-REPORT message	Yes	5 seconds
Folder where DICOM objects should be moved if Storage Commitment fails	Yes	–

4.5 Viewer Applications (Non-DICOM Network Components)

NDP.view2 – Implementation Model

Implementation Model

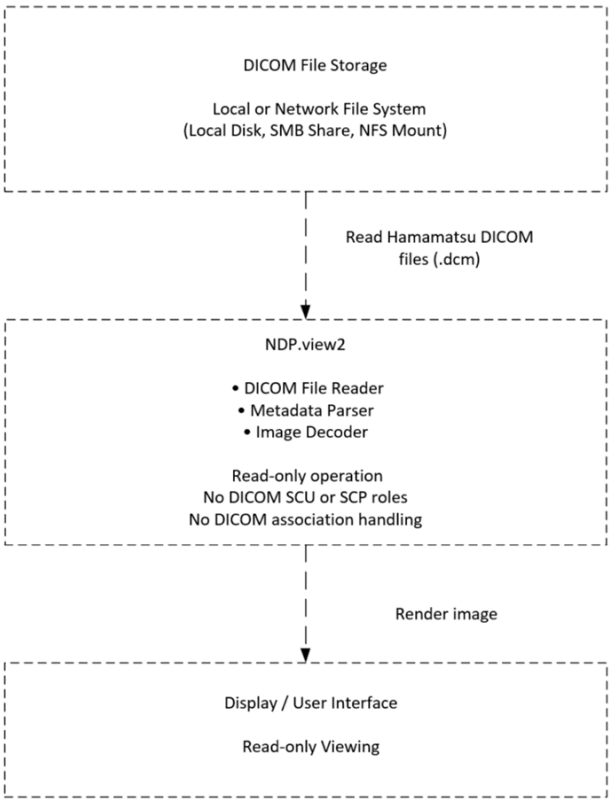
Application Overview

NDP.view2 is a read-only DICOM viewer that reads NanoZoomer-acquired DICOM files from a local or network file system and displays image content to the user.

The application operates in offline mode and does not establish any DICOM network associations.

Access to files on a network file system is performed at the operating system file-system level only and does not involve any DICOM network services or DICOM association handling.

Implementation Model Diagram



5 MEDIA STORAGE

Native DICOM does not support Media Storage.

6 TRANSFORMATION OF DICOM TO CDA

Native DICOM does not support transforming DICOM SR objects to HL7 CDA.

7 SUPPORT OF CHARACTER SETS

Native DICOM supports the character sets listed in Table 7-1 for the STORAGE-SCU Application Entity.

Table 7-1
SUPPORTED CHARACTER SETS

Character Set Description	Defined Term
Latin alphabet No. 1	ISO_IR 100
Unicode in UTF-8	ISO_IR 192

For the activity “New instance reaches front of send queue”, the character set that is used for the created SOP Instances depends on the configuration (see Table 9-1).

8 SECURITY

8.1 Security Profiles

Native DICOM does not support any security profiles.

8.2 Association Level Security

Native DICOM does not support any association level security.

8.3 Application Level Security

Native DICOM does not support any application level security.

9 ANNEXES

9.1 IOD Contents

9.1.1 Created SOP Instances

Abbreviations used for the “Presence of Module” column in the IOD tables:

ALWAYS	Module always present
NEVER	Module never present

Abbreviations used for the “Presence of Value” column in the Module tables:

VNAP	Value Not Always Present (Attribute sent zero length if no value is present)
ANAP	Attribute Not Always Present
ALWAYS	Always present with a value
EMPTY	Attribute is sent without a value
NEVER	Attribute never present

Abbreviations used for the “Source (of the data values)” column in the Module tables:

USER	the Attribute value source is from User input
AUTO	the Attribute value is generated automatically
CONFIG	the Attribute value source is a configurable parameter
LIMS	the Attribute value source is the Laboratory Information Management System

9.1.1.1 VL Whole Slide Microscopy Image IOD

Native DICOM creates one or more DICOM Whole Slide Microscopy Image objects when a new slide is scanned. Details of the image tiling process (e.g., size of image tiles or ratio between pyramid levels), the creation of a separate slide, label and/or thumbnail image, the creation of an embedded icon image, the support of multiple Z-planes (Z-stacks) and other aspects can be configured.

All configurable parameters used for creating DICOM WSI objects are listed in Table 9-1.

Table 9-1
CONFIGURABLE PARAMETERS FOR CREATING DICOM WSI OBJECTS

Parameter	Configurable	Default Value
Character encoding of textual information	Yes	UTF-8
Behavior if conversion of character encoding to “Latin 1” fails	Yes	Replace invalid characters
Replacement for characters that cannot be converted to “Latin 1”	Yes	“”
Option to validate metadata (textual information)	Yes	On
Ratio between pyramid levels (image tiling)	Yes	4
Stop condition for creating pyramid levels	Yes	None
Image tile size (width and height in pixels)	Yes	256
Option to create slide image or label image or both of them	Yes	None
Option to create icon image	Yes	Off
Icon image size (maximum width and height in pixels)	Yes	256
Option to create thumbnail image	Yes	Off
Thumbnail image size (maximum width and height in pixels)	Yes	256

Z-plane(s) to be converted	Yes	All
Option to limit number of tiles per SOP Instance	Yes	Off
Maximum number of tiles per SOP Instance	Yes	10,000
Option to limit size of SOP Instance	Yes	Off
Maximum size of SOP Instance (in megabytes)	Yes	10,000
Option to use Dimension Organization Type “TILED_FULL”	Yes	On
Length encoding of Sequences and Items	Yes	Explicit length
Option to fill Basic or Extended Offset Table for compressed pixel data	Yes	Basic
Full path, including folder and filename, where the created DICOM object should be stored	Yes	–
Filename extension appended to output files (DICOM objects)	No	dcm

The following tables describe the Modules and Attributes of the underlying IOD. Most Attributes that are never present in a created SOP Instance are omitted from the tables in order to increase the readability.

Table 9-2
VL WHOLE SLIDE MICROSCOPY IMAGE IOD MODULES

IE	Module	Reference	Presence of Module
Patient	Patient	Table 9-3	ALWAYS
	Clinical Trial Subject	–	NEVER
Study	General Study	Table 9-4	ALWAYS
	Patient Study	–	NEVER
	Clinical Trial Study	–	NEVER
Series	General Series	Table 9-5	ALWAYS
	Whole Slide Microscopy Series	Table 9-6	ALWAYS
	Clinical Trial Series	–	NEVER
Frame of Reference	Frame of Reference	Table 9-7	ALWAYS
Equipment	General Equipment	Table 9-8	ALWAYS
	Enhanced General Equipment	Table 9-9	ALWAYS
Image	General Image	Table 9-10	ALWAYS
	General Reference	Table 9-11	ALWAYS
	Image Pixel	Table 9-12	ALWAYS
	Acquisition Context	Table 9-13	ALWAYS
	Multi-frame Functional Groups	Table 9-14	ALWAYS
	Multi-frame Dimension	Table 9-15	ALWAYS
	Specimen	Table 9-16	ALWAYS
	Whole Slide Microscopy Image	Table 9-17	ALWAYS
	Optical Path	Table 9-18	ALWAYS
	Slide Label	Table 9-19	Only for slide and label images, i.e., if Image Type (0008,0008) Value 3 is “OVERVIEW” or “LABEL”
	SOP Common	Table 9-20	ALWAYS

	Common Instance Reference	Table 9-21	ALWAYS
	Frame Extraction	–	NEVER

Table 9-3
PATIENT MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	User input or LIMS	VNAP	USER, LIMS
Patient ID	(0010,0020)	LO	User input or LIMS	VNAP	USER, LIMS
Patient's Birth Date	(0010,0030)	DA	User input or LIMS	VNAP	USER, LIMS
Patient's Sex	(0010,0040)	CS	User input or LIMS	VNAP	USER, LIMS

Table 9-4
GENERAL STUDY MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	UI	User input, LIMS or generated automatically	ALWAYS	USER, LIMS, AUTO
Study Date	(0008,0020)	DA	User input, LIMS or generated automatically	VNAP	USER, LIMS, AUTO
Study Time	(0008,0030)	TM	User input, LIMS or generated automatically	VNAP	USER, LIMS, AUTO
Referring Physician's Name	(0008,0090)	PN	User input or LIMS	VNAP	USER, LIMS
Study ID	(0020,0010)	SH	User input or LIMS	VNAP	USER, LIMS
Accession Number	(0008,0050)	SH	User input or LIMS	VNAP	USER, LIMS
Study Description	(0008,1030)	LO	User input or LIMS	ANAP	USER, LIMS

Table 9-5
GENERAL SERIES MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	*See Table 9-6*		
Series Instance UID	(0020,000E)	UI	Generated automatically	ALWAYS	AUTO
Series Number	(0020,0011)	IS	User input, LIMS or empty	VNAP	USER, LIMS, AUTO
Series Date	(0008,0021)	DA		NEVER	–
Series Time	(0008,0031)	TM		NEVER	–
Series Description	(0008,103E)	LO	User input or LIMS	ANAP	USER, LIMS

Table 9-6
WHOLE SLIDE MICROSCOPY SERIES MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	“SM”	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ		NEVER	–

Table 9-7
FRAME OF REFERENCE MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Frame of Reference UID	(0020,0052)	UI	Generated automatically	ALWAYS	AUTO
Position Reference Indicator	(0020,1040)	LO	“SLIDE_CORNER”	ALWAYS	AUTO

Table 9-8
GENERAL EQUIPMENT MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	*See Table 9-9*		
Institution Name	(0008,0080)	LO	User input	ANAP	USER
Institution Address	(0008,0081)	ST	User input	ANAP	USER
Station Name	(0008,1010)	SH	User input	ANAP	USER
Institutional Department Name	(0008,1040)	LO	User input	ANAP	USER
Manufacturer’s Model Name	(0008,1090)	LO	*See Table 9-9*		
Device Serial Number	(0018,1000)	LO	*See Table 9-9*		
Software Versions	(0018,1020)	LO	*See Table 9-9*		

Table 9-9
ENHANCED GENERAL EQUIPMENT MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	“Hamamatsu Photonics K.K.”	ALWAYS	AUTO
Manufacturer’s Model Name	(0008,1090)	LO		ALWAYS	AUTO
Device Serial Number	(0018,1000)	LO		ALWAYS	AUTO
Software Versions	(0018,1020)	LO	Value 1: name and version of the scanner software that was used to acquire the image	ALWAYS	AUTO

			Value 2: name and version of the underlying DICOM WSI software Value 3: name and version of the Native DICOM software package		

Table 9-10
GENERAL IMAGE MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	*See Table 9-14*		
Content Date	(0008,0023)	DA	*See Table 9-14*		
Content Time	(0008,0033)	TM	*See Table 9-14*		
Image Type	(0008,0008)	CS	*See Table 9-17*		
Acquisition DateTime	(0008,002A)	DT	*See Table 9-17*		
Burned In Annotation	(0028,0301)	CS	*See Table 9-17*		
Lossy Image Compression	(0028,2110)	CS	*See Table 9-17*		
Lossy Image Compression Ratio	(0028,2112)	DS	*See Table 9-17*		
Lossy Image Compression Method	(0028,2114)	CS	*See Table 9-17*		
Icon Image Sequence	(0088,0200)	SQ	Only present if option enabled	ANAP	AUTO
>Samples per Pixel	(0028,0002)	US	1	ALWAYS	AUTO
>Photometric Interpretation	(0028,0004)	CS	“PALETTE COLOR”	ALWAYS	AUTO
>Rows	(0028,0010)	US	The maximum value is configurable in the range of 32 to 4096. The actual value used depends on the aspect ratio of the image.	ALWAYS	CONFIG, AUTO
>Columns	(0028,0011)	US	Same maximum value as for Rows (0040,0512). The actual value used depends on the aspect ratio of the image.	ALWAYS	CONFIG, AUTO
>Bits Allocated	(0028,0100)	US	8	ALWAYS	AUTO
>Bits Stored	(0028,0101)	US	8	ALWAYS	AUTO
>High Bit	(0028,0102)	US	7	ALWAYS	AUTO
>Pixel Representation	(0028,0103)	US	0	ALWAYS	AUTO

>Pixel Aspect Ratio	(0028,0034)	IS		NEVER	–
>Red Palette Color Lookup Table Descriptor	(0028,1101)	US	256\0\8	ALWAYS	AUTO
>Green Palette Color Lookup Table Descriptor	(0028,1102)	US	256\0\8	ALWAYS	AUTO
>Blue Palette Color Lookup Table Descriptor	(0028,1103)	US	256\0\8	ALWAYS	AUTO
>Red Palette Color Lookup Table Data	(0028,1201)	OW	Created from scanned image by means of quantization	ALWAYS	AUTO
>Green Palette Color Lookup Table Data	(0028,1202)	OW	Created from scanned image by means of quantization	ALWAYS	AUTO
>Blue Palette Color Lookup Table Data	(0028,1203)	OW	Created from scanned image by means of quantization	ALWAYS	AUTO
>Pixel Data	(7FE0,0010)	OB	Created from scanned image	ALWAYS	AUTO

Table 9-11
GENERAL REFERENCE MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Derivation Description	(0008,2111)	ST	Generated automatically based on compression details of the source image. Only present if the image is derived, e.g., a thumbnail image.	ANAP	AUTO
Derivation Code Sequence	(0008,9215)	SQ		NEVER	–

Table 9-12
IMAGE PIXEL MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Samples per Pixel	(0028,0002)	US	*See Table 9-17*		
Photometric Interpretation	(0028,0004)	CS	*See Table 9-17*		
Rows	(0028,0010)	US	For tiled images: 256, 512, 1024, 2048 or 4096 For thumbnail image (maximum value):	ALWAYS	CONFIG, AUTO

			any value in the range of 128 to 4096 For slide and label image: from scanned image (For slide and label images, the actual value used depends on the aspect ratio of the image.)		
Columns	(0028,0011)	US	For slide and label image: from scanned image For all other images: same maximum value as for Rows (0040,0512). (The actual value used depends on the aspect ratio of the image.)	ALWAYS	CONFIG, AUTO
Bits Allocated	(0028,0100)	US	*See Table 9-17*		
Bits Stored	(0028,0101)	US	*See Table 9-17*		
High Bit	(0028,0102)	US	*See Table 9-17*		
Pixel Representation	(0028,0103)	US	*See Table 9-17*		
Planar Configuration	(0028,0006)	US	*See Table 9-17*		
Pixel Aspect Ratio	(0028,0034)	IS		NEVER	–
ICC Profile	(0028,2000)	OB		NEVER	–
Color Space	(0028,2002)	CS		NEVER	–
Pixel Data	(7FE0,0010)	OB	Created from scanned image	ALWAYS	AUTO
Extended Offset Table	(7FE0,0001)	OV	Only present if option enabled	ANAP	AUTO
Extended Offset Table Lengths	(7FE0,0002)	OV	Only present if option enabled	ANAP	AUTO

Table 9-13
ACQUISITION CONTEXT MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Context Sequence	(0040,0555)	SQ		EMPTY	–
Acquisition Context Description	(0040,0556)	ST		NEVER	–

Table 9-14
MULTI-FRAME FUNCTIONAL GROUPS MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Shared Functional Groups Sequence	(5200,9229)	SQ		ALWAYS	AUTO
>Pixel Measures Sequence	(0028,9110)	SQ		ALWAYS	AUTO
>>Pixel Spacing	(0028,0030)	DS	From scanned image	ALWAYS	AUTO
>>Slice Thickness	(0018,0050)	DS	From scanned image (if available), the default is 0.00111 mm	ALWAYS	AUTO
>>Spacing Between Slices	(0018,0088)	DS	Calculated from scanned image. Only present if more than one focal plane is stored.	ANAP	AUTO
>Optical Path Identification Sequence	(0048,0207)	SQ		ANAP	AUTO
>>Optical Path Identifier	(0048,0106)	SH	Same value as in Optical Path Module *(see Table 9-18)*	ALWAYS	AUTO
>Whole Slide Microscopy Image Frame Type Sequence	(0040,0710)	SQ		ALWAYS	AUTO
>>Frame Type	(0008,9007)	CS	Same value as for Image Type (0008,0008)	ALWAYS	AUTO
Per-frame Functional Groups Sequence	(5200,9230)	SQ		ANAP	AUTO
>Frame Content Sequence	(0020,9111)	SQ		ANAP	AUTO
>>Dimension Index Values	(0020,9157)	UL	Tile number	ALWAYS	AUTO
>Plane Position (Slide) Sequence	(0048,021A)	SQ		ANAP	AUTO
>>Column Position In Total Pixel Matrix	(0048,021E)	SL		ALWAYS	AUTO
>>Row Position In Total Pixel Matrix	(0048,021F)	SL		ALWAYS	AUTO
>>X Offset in Slide Coordinate System	(0040,072A)	DS		ALWAYS	AUTO
>>Y Offset in Slide Coordinate System	(0040,073A)	DS		ALWAYS	AUTO
>>Z Offset in Slide Coordinate System	(0040,074A)	DS		ALWAYS	AUTO

Instance Number	(0020,0013)	IS	User input or consecutive number starting with 1	ALWAYS	USER, AUTO
Content Date	(0008,0023)	DA	Current system date	ALWAYS	AUTO
Content Time	(0008,0033)	TM	Current system time	ALWAYS	AUTO
Number of Frames	(0028,0008)	IS	*See Table 9-17*		
Concatenation Frame Offset Number	(0020,9228)	UL	Generated automatically	ANAP	AUTO
Concatenation UID	(0020,9161)	UI	Generated automatically	ANAP	AUTO
SOP Instance UID of Concatenation Source	(0020,0242)	UI	From internally created SOP Instance	ANAP	AUTO
In-concatenation Number	(0020,9162)	US	Generated automatically	ANAP	AUTO

Table 9-15
MULTI-FRAME DIMENSION MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Dimension Organization Sequence	(0020,9221)	SQ	Contains a single Item only	ALWAYS	AUTO
>Dimension Organization UID	(0020,9164)	UI	Generated automatically	ALWAYS	AUTO
Dimension Organization Type	(0020,9311)	CS	“TILED_FULL” or “TILED_SPARSE”	ALWAYS	CONFIG
Dimension Index Sequence	(0020,9222)	SQ	Contains a single Item only	ANAP	AUTO
>Dimension Index Pointer	(0020,9165)	AT	(0048,021A)	ALWAYS	AUTO
>Dimension Organization UID	(0020,9164)	UI	*See above*	ALWAYS	AUTO
>Dimension Description Label	(0020,9421)	LO	“Plane Position (Slide)”	ALWAYS	AUTO

Table 9-16
SPECIMEN MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Container Identifier	(0040,0512)	LO	User input or LIMS	ALWAYS	USER, LIMS
Issuer of the Container Identifier Sequence	(0040,0513)	SQ		VNAP	AUTO
>Universal Entity ID	(0040,0032)	UT	User input	ALWAYS	USER
>Universal Entity ID Type	(0040,0033)	CS	User input	ALWAYS	USER

Container Type Code Sequence	(0040,0518)	SQ		EMPTY	–
Container Description	(0040,051A)	LO	User input or LIMS	ANAP	USER, LIMS
Specimen Description Sequence	(0040,0560)	SQ		VNAP	AUTO
>Specimen Identifier	(0040,0551)	LO	User input or LIMS, by default same value as for Container Identifier (0040,0512)	ALWAYS	USER, LIMS, AUTO
>Issuer of the Specimen Identifier Sequence	(0040,0562)	SQ		EMPTY	–
>Specimen UID	(0040,0554)	UI	User input, LIMS or generated automatically	ALWAYS	USER, LIMS, AUTO
>Specimen Type Code Sequence	(0040,059A)	SQ		ANAP	AUTO
>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS
>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–
>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS
>Specimen Short Description	(0040,0600)	LO	User input or LIMS	ANAP	USER, LIMS
>Specimen Detailed Description	(0040,0602)	UT	User input or LIMS	ANAP	USER, LIMS
>Specimen Preparation Sequence	(0040,0610)	SQ		VNAP	AUTO
>>Specimen Preparation Step Content Item Sequence	(0040,0612)	SQ		ALWAYS	AUTO
>>>Value Type	(0040,A040)	CS	“TEXT”, “CODE”, “DATETIME”, “NUMERIC” or “IMAGE”	ALWAYS	AUTO
>>>Concept Name Code Sequence	(0040,A043)	SQ		ALWAYS	AUTO
>>>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS

>>>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–
>>>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS
>>>DateTime	(0040,A120)	DT	User input or LIMS	ANAP	USER, LIMS
>>>Text Value	(0040,A160)	UT	User input or LIMS	ANAP	USER, LIMS
>>>Concept Code Sequence	(0040,A168)	SQ		ANAP	AUTO
>>>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS
>>>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–
>>>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS
>>>Numeric Value	(0040,A30A)	DS	User input or LIMS	ALWAYS	USER, LIMS
>>>Measurement Units Code Sequence	(0040,08EA)	SQ		ANAP	AUTO
>>>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS
>>>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–
>>>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS
>>>Referenced SOP Sequence	(0008,1199)	SQ		ANAP	AUTO
>>>>Referenced SOP Class UID	(0008,1150)	UI	User input or LIMS	ALWAYS	USER, LIMS
>>>>Referenced SOP Instance UID	(0008,1155)	UI	User input or LIMS	ALWAYS	USER, LIMS
>>>>Referenced Frame Number	(0008,1160)	IS	User input or LIMS	ANAP	USER, LIMS
>Primary Anatomic Structure Sequence	(0008,2228)	SQ		ANAP	AUTO
>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS
>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–

>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS
>>Primary Anatomic Structure Modifier Sequence	(0008,2230)	SQ		ANAP	AUTO
>>>Code Value	(0008,0100)	SH	User input or LIMS	ANAP	USER, LIMS
>>>Long Code Value	(0008,0119)	UC	User input or LIMS	ANAP	USER, LIMS
>>>URN Code Value	(0008,0120)	UR	User input or LIMS	ANAP	USER, LIMS
>>>Coding Scheme Designator	(0008,0102)	SH	User input or LIMS	ALWAYS	USER, LIMS
>>>Coding Scheme Version	(0008,0103)	SH	User input or LIMS	NEVER	–
>>>Code Meaning	(0008,0104)	LO	User input or LIMS	ALWAYS	USER, LIMS

Table 9-17
WHOLE SLIDE MICROSCOPY IMAGE MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Image Type	(0008,0008)	CS	Value 1: “ORIGINAL” or “DERIVED” Value 2: “PRIMARY” Value 3: “VOLUME”, “LABEL”, “OVERVIEW” or “THUMBNAIL” Value 4: “NONE” or “RESAMPLED”	ALWAYS	AUTO
Imaged Volume Width	(0048,0001)	FL	From scanned image	ALWAYS	AUTO
Imaged Volume Height	(0048,0002)	FL	From scanned image	ALWAYS	AUTO
Imaged Volume Depth	(0048,0003)	FL	From scanned image	ALWAYS	AUTO
Total Pixel Matrix Columns	(0048,0006)	UL	Calculated based on size of scanned image	ALWAYS	AUTO
Total Pixel Matrix Rows	(0048,0007)	UL	Calculated based on size of scanned image	ALWAYS	AUTO
Total Pixel Matrix Focal Planes	(0048,0303)	UL	For volume image, number of scanned focal planes. For slide, label and thumbnail image, always “1”.	ALWAYS	AUTO
Total Pixel Matrix Origin Sequence	(0048,0008)	SQ		ALWAYS	AUTO
>X Offset in Slide Coordinate System	(0040,072A)	DS	Calculated from scanned image	ALWAYS	AUTO
>Y Offset in Slide Coordinate System	(0040,073A)	DS	Calculated from scanned image	ALWAYS	AUTO

Image Orientation (Slide)	(0048,0102)	DS	0\-1\0\-1\0\0	ALWAYS	AUTO
Samples Per Pixel	(0028,0002)	US	3	ALWAYS	AUTO
Photometric Interpretation	(0028,0004)	CS	“YBR_FULL_422”	ALWAYS	AUTO
Planar Configuration	(0028,0006)	US	0	ALWAYS	AUTO
Number of Frames	(0028,0008)	IS	For volume image, calculated based on image tiling. For slide, label and thumbnail image, always “1”.	ALWAYS	AUTO
Bits Allocated	(0028,0100)	US	8	ALWAYS	AUTO
Bits Stored	(0028,0101)	US	8	ALWAYS	AUTO
High Bit	(0028,0102)	US	7	ALWAYS	AUTO
Pixel Representation	(0028,0103)	US	0	ALWAYS	AUTO
Acquisition DateTime	(0008,002A)	DT	Date and time when the acquisition started	ALWAYS	AUTO
Lossy Image Compression	(0028,2110)	CS	“01”	ALWAYS	AUTO
Lossy Image Compression Ratio	(0028,2112)	DS	Estimated based on typical JPEG compression ratios	ALWAYS	AUTO
Lossy Image Compression Method	(0028,2114)	CS	“ISO_10918_1“	ALWAYS	AUTO
Volumetric Properties	(0008,9206)	CS	“VOLUME”	ALWAYS	AUTO
Specimen Label in Image	(0048,0010)	CS	For slide image and label image: “YES” For all other images: “NO”	ALWAYS	AUTO
Burned In Annotation	(0028,0301)	CS	“NO”	ALWAYS	AUTO
Focus Method	(0048,0011)	CS	“MANUAL” if any user intervention was used during autofocus, otherwise “AUTO”	ALWAYS	AUTO
Extended Depth of Field	(0048,0012)	CS	“NO”	ALWAYS	AUTO
Number of Focal Planes	(0048,0013)	US		NEVER	–
Distance Between Focal Planes	(0048,0014)	FL		NEVER	–

Table 9-18
OPTICAL PATH MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Number of Optical Paths	(0048,0302)	UL	1	ALWAYS	AUTO
Optical Path Sequence	(0048,0105)	SQ		ALWAYS	AUTO
>Optical Path Identifier	(0048,0106)	SH	User input or default, which is “1”	ALWAYS	USER, AUTO
>Optical Path Description	(0048,0107)	ST	User input or default, which is “Brightfield”	ANAP	USER, AUTO
>Illumination Color Code Sequence	(0048,0108)	SQ		ALWAYS	AUTO
>>Code Value	(0008,0100)	SH	The following code is used for all images: (414298005, “SCT”, “Full Spectrum”)	ALWAYS	AUTO
>>Coding Scheme Designator	(0008,0102)	SH		ALWAYS	AUTO
>>Code Meaning	(0008,0104)	LO		ALWAYS	AUTO
>Illumination Type Code Sequence	(0022,0016)	SQ	Contains two Items	ALWAYS	AUTO
>>Code Value	(0008,0100)	SH	Depending on the type of image, the following codes are used: - (111744, “DCM”, “Brightfield illumination”) and (111742, “DCM”, “Reflection illumination”) for slide and label images; - (111744, “DCM”, “Brightfield illumination”) and (111741, “DCM”, “Transmission illumination”) for all other images.	ALWAYS	AUTO
>>Coding Scheme Designator	(0008,0102)	SH		ALWAYS	AUTO
>>Code Meaning	(0008,0104)	LO		ALWAYS	AUTO
>ICC Profile	(0028,2000)	OB	From scanner model specific file, e.g. Gamma 2.2 generated profile	ALWAYS	AUTO
>Color Space	(0028,2002)	CS		NEVER	–

Table 9-19
SLIDE LABEL MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Barcode Value	(2200,0005)	LT	Automatically read from slide label, using user defined parameters	VNAP	AUTO
Label Text	(2200,0002)	UT		EMPTY	–

Table 9-20
SOP COMMON MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	“1.2.840.10008.5.1.4.1.1.77.1.6”	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	Generated automatically	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	“ISO_IR 100” or “ISO_IR 192”	ALWAYS	CONFIG
Instance Creation Date	(0008,0012)	DA		NEVER	–
Instance Creation Time	(0008,0013)	TM		NEVER	–
Instance Creator UID	(0008,0014)	UI		NEVER	–
Coding Scheme Identification Sequence	(0008,0110)	SQ		NEVER	–
Timezone Offset From UTC	(0008,0201)	SH		NEVER	–
Contributing Equipment Sequence	(0018,A001)	SQ		NEVER	–
Instance Number	(0020,0013)	IS	*See Table 9-14*		
Content Qualification	(0018,9004)	CS		NEVER	–

Table 9-21
COMMON INSTANCE REFERENCE MODULE OF CREATED SOP INSTANCES

Attribute Name	Tag	VR	Value	Presence of Value	Source
Referenced Series Sequence	(0008,1115)	SQ		NEVER	–
Studies Containing Other Referenced Instances Sequence	(0008,1200)	SQ		NEVER	–

9.1.2 Usage of Attribute from Received IODs

Native DICOM does not receive any DICOM objects.

9.1.3 Attribute Mapping

Native DICOM does not use any Attribute mapping.

9.1.4 Coerced / Modified Fields

Native DICOM does not coerce or modify any fields.

9.2 Data Dictionary of Private Attributes

Native DICOM does not use or support Private Attributes.

9.3 Coded Terminology and Templates

Native DICOM does not use any templates. Coded terminology is only used for created SOP Instances as described in Section 9.1.1. The codes are either predefined or provided by the user or the Laboratory Information Management System (LIMS).

9.4 Grayscale Image Consistency

Native DICOM does not make use of the DICOM Grayscale Standard Display Function.

9.5 Standard Extended / Specialized / Private SOP Classes

Native DICOM does not use or support any Standard Extended, Specialized or Private SOP Classes.

9.6 Private Transfer Syntaxes

Native DICOM does not use or support any Private Transfer Syntaxes.