



NumaStore 1.0 DICOM 3.0 Conformance Statement

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Introduction

*"In the conduct of our foreign relations I shall conform to these views,
as I believe them essential to the best interests and the true honor of the country."*

Zachary Taylor

This document states the conformance of NumaStore 1.0 to the DICOM 3.0 standard. It is written according to part PS 3.2-1999 of Digital Imaging and Communications in Medicine (DICOM) 3.0¹.

NumaStore is a medical image archive system tailored to the needs of nuclear medicine. It provides long-term, expandable storage, cataloging, and retrieval of nuclear medicine images.

Version 1 of this product uses the DICOM-conformant nuclear medicine workstations and viewers of other vendors to provide its store/query/retrieve client interface. NumaStore is a Service Class Provider for the DICOM Query/Retrieve Service Class, and a Service Class Provider and Service Class User for the DICOM Storage Service Class. In other words, DICOM-compliant nuclear medicine workstations and viewers, using the vendor-supplied user interface for these functions, can store images to NumaStore, query on various demographic data of the images stored, and retrieve those images.

Symbols and Abbreviations

ACR	American College of Radiology
AE	Application Entity
DICOM	Digital Imaging and Communications in Medicine
GUI	Graphic User Interface
NEMA	National Electrical Manufacturers Association
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
VR	Value Representation

¹ National Electrical Manufacturers Association, 1300 N. 17th Street, Rosslyn, Virginia 22209, USA
<http://medical.nema.org/dicom.html>

1 Implementation Model

NumaStore provides a long term, scalable capacity storage facility tailored to nuclear medicine. This implementation supports the transfer of nuclear medicine images using the DICOM Storage Service Class as both a service Class Provider (SCP) and a Service Class User (SCU). It stores images sent to it by service class users, executes queries based on several standard DICOM query models and retrieves requested images.

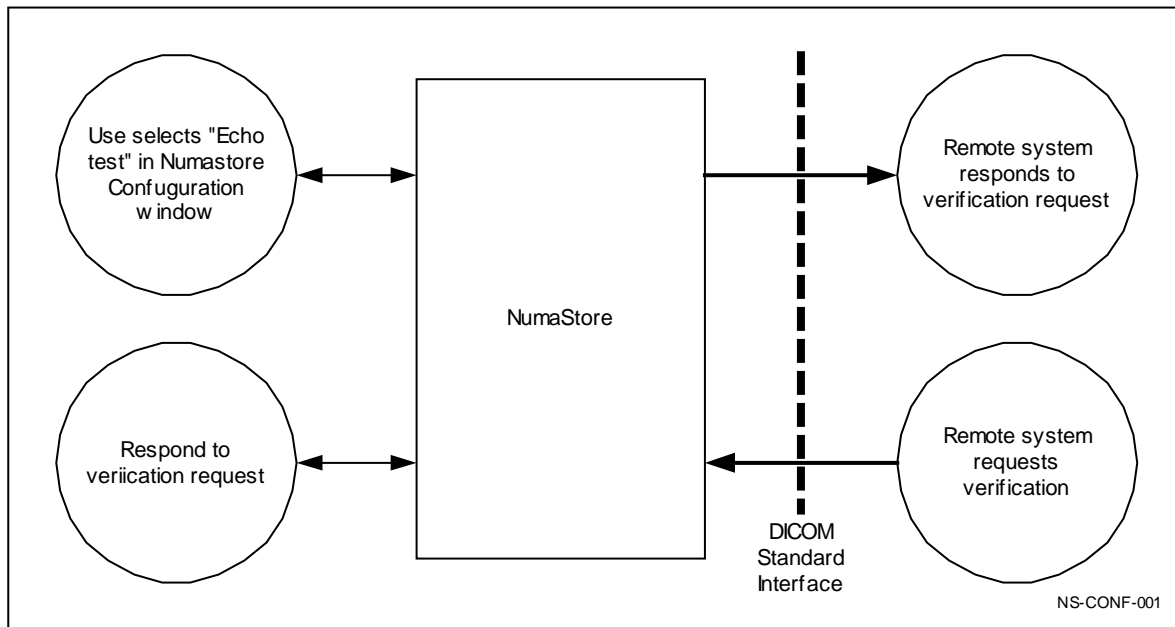
This implementation also supports communications testing using the DICOM Verification Service Class as both an SCP and an SCU.

1.1 Application Data Flow Diagram

1.1.1 Verification

NumaStore allows a local user to verify connectivity with a remote system. NumaStore also responds to verification requests from remote systems.

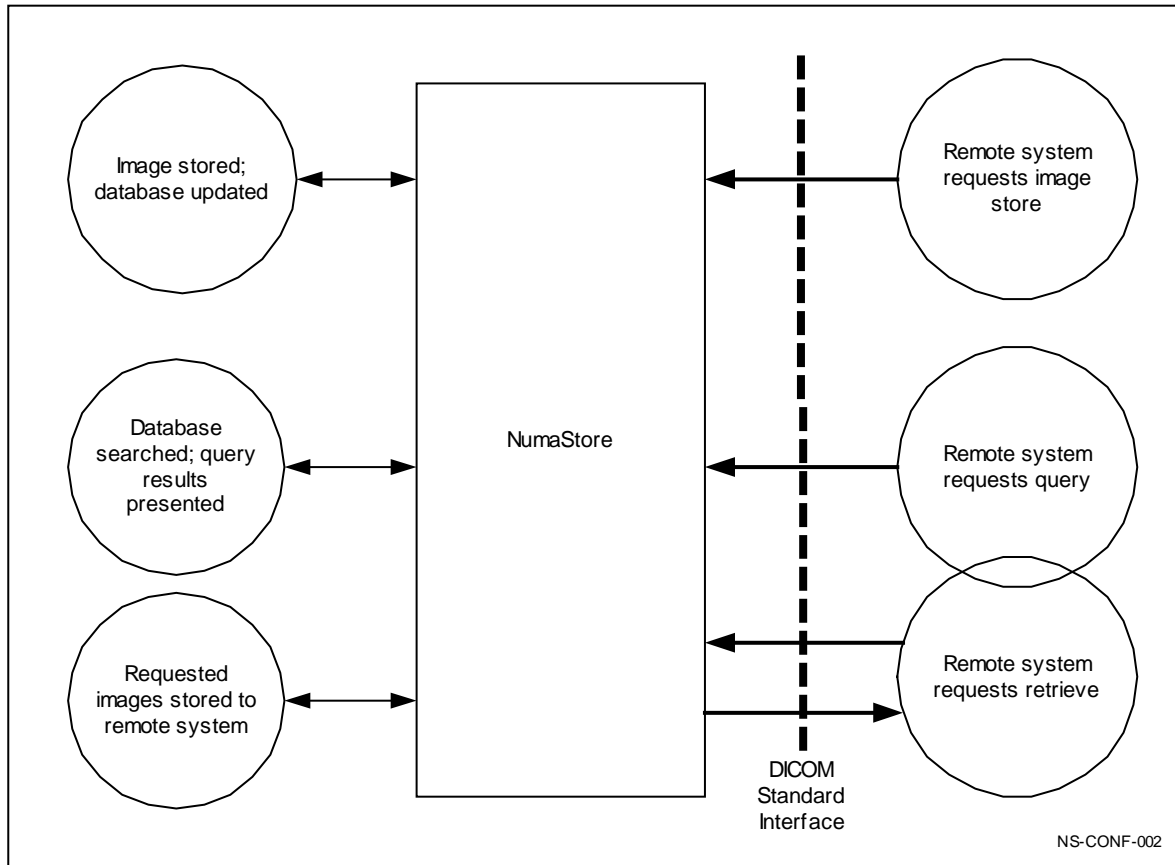
Figure 1-1 – Verification Data Flow



1.1.2 Store/Query/Retrieve

A remote system can store images in NumaStore, query on the images stored and retrieve requested images.

Figure 1-2 -- Store/Query/Retrieve Data Flow



1.2 Functional Definitions of Application Entities

NumaStore runs as a service on Windows NT. Once installed and configured, this service is normally available whenever the system is available.

NumaStore administration functions are available through an administrative graphic user interface (GUI). Among the administrative functions are:

- internal data store configuration and expansion
- control of (lossless) data store compression
- management of remote AE information, and verification of communication
- manual deletion of old images

1.2.1 Verification

NumaStore uses the C-ECHO primitive of the Verification SOP Class as an SCU to verify application level communication with a remote system. To verify communications, a user:

1. selects the Configuration window in the administrative GUI;

2. supplies a remote AE Title, TCP/IP address and port number;
3. clicks on "Echo Test".

The results of the test are displayed in a message window.

NumaStore also responds automatically as an SCP to such requests from remote systems, using the C-ECHO primitive.

1.2.2 Store

NumaStore uses C-STORE service of the Storage Service Class as an SCP to store images on its internal data store. Images stored using this service are stored in their entirety as received from the SCU, in properly formatted DICOM files.

NumaStore extracts patient, study, series and image data from a stored image and updates its internal database with this information to support subsequent queries(see section 1.2.3).

1.2.3 Query

NumaStore uses the C-FIND service of the Query/Retrieve Service Class as an SCP to respond to a query from an SCU. Query responses are based on patient, study, series and mage information maintained in NumaStore's internal database as a result of previous store operations (see section 1.2.2).

All three Query/Retrieve Information Models are supported (Patient Root, Study Root and Patient/Study Only).

NumaStore does not support:

- priority processing of queries
- relational queries

1.2.4 Retrieve

NumaStore uses the C-MOVE service of the Query/Retrieve Service Class as an SCP to respond to a retrieve request from an SCU. It does so by obtaining from its database a reference to a requested image, retrieving the image from its internal data store and performing a C_STORE (as SCU) of the requested image to the requesting AE.

1.3 Sequencing of Real World Activities

Not applicable.

2 Application Entity Specifications

2.1 NumaStore – Specification

2.1.1 Association Establishment Policies

2.1.1.1 General

NumaStore waits for an association as an SCP of Storage and Query/Retrieve Service Classes.

When a Store request is received, NumaStore saves the corresponding images to its internal disk store, and updates its internal database with appropriate patient, study, series and image attributes.

When a Find request is received, NumaStore searches its internal database for images with the requested attributes, and returns a list of found attributes to the requesting SCU. Extended negotiation for relational queries is not supported.

When a Move request is received, NumaStore identifies the set of images to be transferred and calls its Storage Service Class SCU, which transfers the set of images to a remote Storage Service Class SCP.

The maximum PDU size is 28672 bytes.

2.1.1.2 Number of Associations

There is no inherent limit to the number of associations other than limits imposed by the computer operating system.

2.1.1.3 Asynchronous Nature

NumaStore does not support asynchronous communication (multiple outstanding transactions over a single association).

2.1.1.4 Implementation Identifying Information

NumaStore responds with the following implementation identifying parameters.

Table 2-1 -- NumaStore Implementatin Identifying Information

Tag	Name	Value
(0002,0012)	Implementation Class UID	1.2.826.0.1.3680043.2.59.2
(0002,0013)	Implementation Version Name	NumaStore 0.1

2.1.1.5 Storage as SCP

Table 2-2 lists the SOP classes that NumaStore supports as an SCP for storage services.

Table 2-2 -- NumaStore Storage SOP Classes

SOP Class	UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Stand-alone Curve Storage	1.2.840.10008.5.1.4.1.1.9
Stand-alone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
Stand-alone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
Stand-alone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Stored Print Storage	1.2.840.10008.5.1.1.27
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
Genie Private Storage	1.2.840.113619.4.27

2.1.1.6 Query/Retrieve as SCP

Table 2-3 lists the SOP classes that NumaStore supports as an SCP for storage services.

Table 2-3 – NumaStore Query/Retrieve SOP Classes

SOP Class	UID
Patient Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient/Study Only Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2

2.1.1.7 Transfer Syntaxes

Table 2-4 lists the transfer syntaxes that NumaStore supports as an SCP.

In this table, transfer syntaxes are listed in the order in which NumaStore will select them during association negotiation.

Table 2-4 – Transfer Syntaxes

Transfer Syntax	UID
DICOM Implicit VR Little Endian	1.2.840.10008.1.2
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1
DICOM Explicit VR Big Endian	1.2.840.10008.1.2.2.

2.1.2 Association Initiation by Real-World Activity

NumaStore initiates an association in response to the following real-world activities:

1. Verification (section 2.1.2.1)

2.1.2.1 Real World Activity 1 – Verification

2.1.2.1.1 Associated Real-World Activity

A user selects "Echo Test" in the NumaStore Configuration window (see section 1.2.1).

2.1.2.1.2 Proposed Presentation Contexts

Presentation Contexts					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	All Table 2-4		SCU	None

2.1.2.1.2.1 SOP Specific Conformance Statement -- Verification

NumaStore provides standard conformance for the Verification Service Class.

2.1.3 Association Acceptance Policy

NumaStore accepts an association in response to the following real-world activities initiated by a remote AE:

1. Verification (section 2.1.3.1)
2. Store (section 2.1.3.2)
3. Query/Retrieve (section 2.1.3.3)

2.1.3.1 Real World Activity 1 – Verification

2.1.3.1.1 Associated Real-World Activity

A remote AE verifies communication with NumaStore (see section 1.2.1).

2.1.3.1.2 Presentation Context Table

Presentation Contexts					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name List	UID List		
Verification	1.2.840.10008.1.1	All Table 2-4		SCP	None

2.1.3.1.2.1 SOP Specific Conformance Statement -- Verification

NumaStore provides standard conformance for the Verification Service Class. NumaStore presents the following status code:

Service Status	Status Description	Status Codes (0000,0900)	Related Fields
Success	Operation performed properly.	0000	None

2.1.3.1.3 Presentation Context Acceptance Criterion

NumaStore will always accept a Presentation Context for the Verification SOP Class with the DICOM Default Transfer Syntax.

2.1.3.1.4 Transfer Syntax Selection Policies

See section 2.1.1.7.

2.1.3.2 Real World Activity 2 – Store

2.1.3.2.1 Associated Real-World Activity

A remote AE stores images in NumaStore (see section 1.2.2).

2.1.3.2.2 Presentation Context Table

Presentation Contexts					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name List	UID List		
	All Table 2-2		All Table 2-4	SCP	None

2.1.3.2.2.1 SOP Specific Conformance Statement – Storage SOP Classes

NumaStore responds to a C-STORE request with one of the following status codes:

Service Status	Status Description	Status Codes (0000,0900)	Related Fields
Refused	Out of Resources NumaStore attempted to perform the requested storage, but did not succeed	A700	None
Error	Cannot Understand NumaStore did not attempt to perform the requested storage.	C000	None
Success	Operation performed properly	0000	None

2.1.3.2.3 Presentation Context Acceptance Criterion

A single presentation context for each Storage Service Class is supported.

2.1.3.2.4 Transfer Syntax Selection Policies

See section 2.1.1.7.

2.1.3.3 Real World Activity 3 – Query/Retrieve

2.1.3.3.1 Associated Real-World Activity

A remote AE queries on images in NumaStore (see section 1.2.3). The remote AE then retrieves specific images from NumaStore.

2.1.3.3.2 Presentation Context Table

Presentation Contexts					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name List	UID List		
All Table 2-3		All Table 2-4		SCP	None

2.1.3.3.2.1 SOP Specific Conformance Statement – Query/Retrieve SOP Classes

SOP classes of the Query/Retrieve Service Class are implemented via the DIMSE C-FIND and C-MOVE services as defined in Part 7 of the DICOM standard. Only hierarchical queries are supported. NumaStore supports all three Query/Retrieve information models:

- Patient Root
- Study Root
- Patient/Study Only

Wild card key values and date and time ranges are supported.

Table 2-5 lists the optional keys that NumaStore supports for the Query/Retrieve Service Classes.

Table 2-5 – Query/Retrieve Optional Keys

Tag	Name	Notes
(0010,0030)	Patient's Birth Date	
(0010,0040)	Patient's Sex	
(0010,1001)	Other Patient Names	one value only
(0008,0090)	Referring Physician's Name	
(0008,1030)	Study Description	
(0008,1060)	Name of Physician(s) Reading Study	one value only
(0008,1080)	Admitting Diagnosis Description	one value only
(0008,1010)	Station Name	
(0008,103E)	Series Description	

NumaStore responds to a C-FIND request with one of the following status codes:

Service Status	Status Description	Status Codes (0000,0900)	Related Fields
Pending	Matches are continuing.	FF00	Identifier containing the Query/Retrieve Level and matched values
Cancel	Matching was terminated due to receipt of a cancel request.	FE00	None
Success	Matching is complete.	0000	None

NumaStore responds to a C-MOVE request with one of the following status codes:

Service Status	Status Description	Status Codes (0000,0900)	Related Fields
Cancel	C-STORE sub-operations were terminated due to receipt of a cancel request.	FE00	None
Success	C-STORE sub-operations complete	0000	None

2.1.3.3.3 Presentation Context Acceptance Criterion

A single presentation context for each Storage Service Class is supported.

2.1.3.3.4 Transfer Syntax Selection Policies

See section 2.1.1.7.

3 Communication Profiles

3.1 Supported Communication Stacks

NumaStore provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

3.1.1 TCP/IP Stack

NumaStore uses the TCP/IP stack from the Windows NT system upon which it executes.

3.1.1.1 Physical Media Support

NumaStore is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Windows NT system upon which it executes.

4 Extensions/Specializations/Privatizations

None supported.

5 Configuration

5.1 AE Title/Presentation Address Mapping

NumaStore provides an administrative interface that allows the user to configure:

- the NumaStore AE Title (default is "NumaStore")
- the local port number on which NumaStore communicates (default is 104)
- the TCP/IP address, port number and AE Title of remote AEs with which NumaStore can communicate.

5.2 Configurable Parameters

NumaStore does not present any configurable parameters other than those listed in section 5.1

6 Support for Extended Character Sets

NumaStore does not support extended character sets.

7 Codes and Controlled Terminology

The SOP Classes supported by this implementation do not support the use of Codes and Controlled Terminology.