Philips Medical Systems
DICOM Conformance Statement

EasyGuide Neuro 1.1

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**Philips
Medical
Systems**

PHILIPS

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1 Introduction

This chapter provides general information about the purpose, scope and contents of this Conformance Statement.

1.1 Scope and field of application

The scope of this DICOM Conformance Statement is to facilitate data exchange with equipment of Philips Medical Systems. This document specifies the compliance to the DICOM standard (formally called the NEMA PS 3.X-1993 standards). It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are: the supported DICOM Service Object Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntaxes.

The field of application is the integration of the Philips Medical Systems equipment into an environment of medical devices.
This Conformance Statement should be read in conjunction with the DICOM standard and its addenda. The conformance to the DICOM standard is a key element of the Inturis Program (see [INTURIS]).

1.2 Intended audience

This Conformance Statement is intended for:
• potential clients,
• system integrators of medical equipment,
• marketing staff interested in system functionality,
• software designers implementing DICOM interfaces.

It is assumed that the reader is familiar with the DICOM standard.

1.3 Contents and structure

The DICOM Conformance Statement is contained in chapter 2 through 7 and follows the contents and structuring requirements of DICOM PS 3.2-1993 and Supplement 2 (in case of Media specifications).
Additionally, the chapters following 7 specify the details of the applied IODs.

1.4 Used definitions, terms and abbreviations

DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see NEMA PS 3.3-1993 and PS 3.4-1994.
The word Philips in this document refers to Philips Medical Systems.

1.5 References

[DICOM]   The Digital Imaging and Communications in Medicine (DICOM) standard:
NEMA PS 3.X (X refers to the part 1 - 13) and Supplements
National Electrical Manufacturers Association (NEMA) Publication Sales
1300 N. 17th Street, Suite 1847
Rosslyn, Va. 22209, United States of America

[INTURIS]   Philips Inturis Program
Integrated Clinical Solutions
Philips Medical Systems Nederland B.V. (see address at page ii)

1.6 Important note to the reader

This Conformance Statement by itself does not guarantee successful interoperability of Philips equipment with non-Philips equipment. The user (or user's agent) should be aware of the following issues:

- **Interoperability**

  Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment. It is the user's responsibility to analyse thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.

- **Validation**

  Philips equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement.
  Where Philips equipment is linked to non-Philips equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

- **New versions of the DICOM Standard**

  The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Philips is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Philips reserves the right to make changes to its products or to discontinue its delivery.
  The user should ensure that any non-Philips provider linking to Philips equipment, also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Philips equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

2 Implementation model

The Philips Medical Systems EasyGuide Neuro (EGN) 1.1 system is a medical imaging work-station application. It provides the following features:
- The application receives images sent to it by remote applications (e.g. workstations or imaging modalities) and stores them in a local database.
- The application allows the operator to copy images from the local database to remote data-bases and vice versa. For this purpose the operator is allowed to query remote databases.
- The application allows a remote system to query the EGN local database and to retrieve images from it.
- The application allows the operator, among other things, to view, to analyse and to process the images stored in the local database.

The remote database access and image transfer functions are implemented using the DICOM Query/Retrieve and STORE services.

The viewing, analysis and processing functions are primarily designed for images generated by Philips equipment and that are sent to the EGN by means of PMSNet, the Philips Medical Systems proprietary communication protocol. Some of these functions may not perform optimally when applied to images that are sent to EGN by means of DICOM. For example viewing of overlays, curves and colour images is not supported.

2.1 Application Data Flow Diagram

The EGN system behaves as a single application entity. The related Implementation Model is shown in Figure 1 on page 4.

2.2 Functional definition of Application Entities

The EGN application entity acts as a service class user of Query/Retrieve and STORE service classes. The application acts as a service class provider of verification, Query/Retrieve and STORE service classes.

2.3 Sequencing of Real World Activities

Not applicable.

Figure 1: EGN Implementation Model
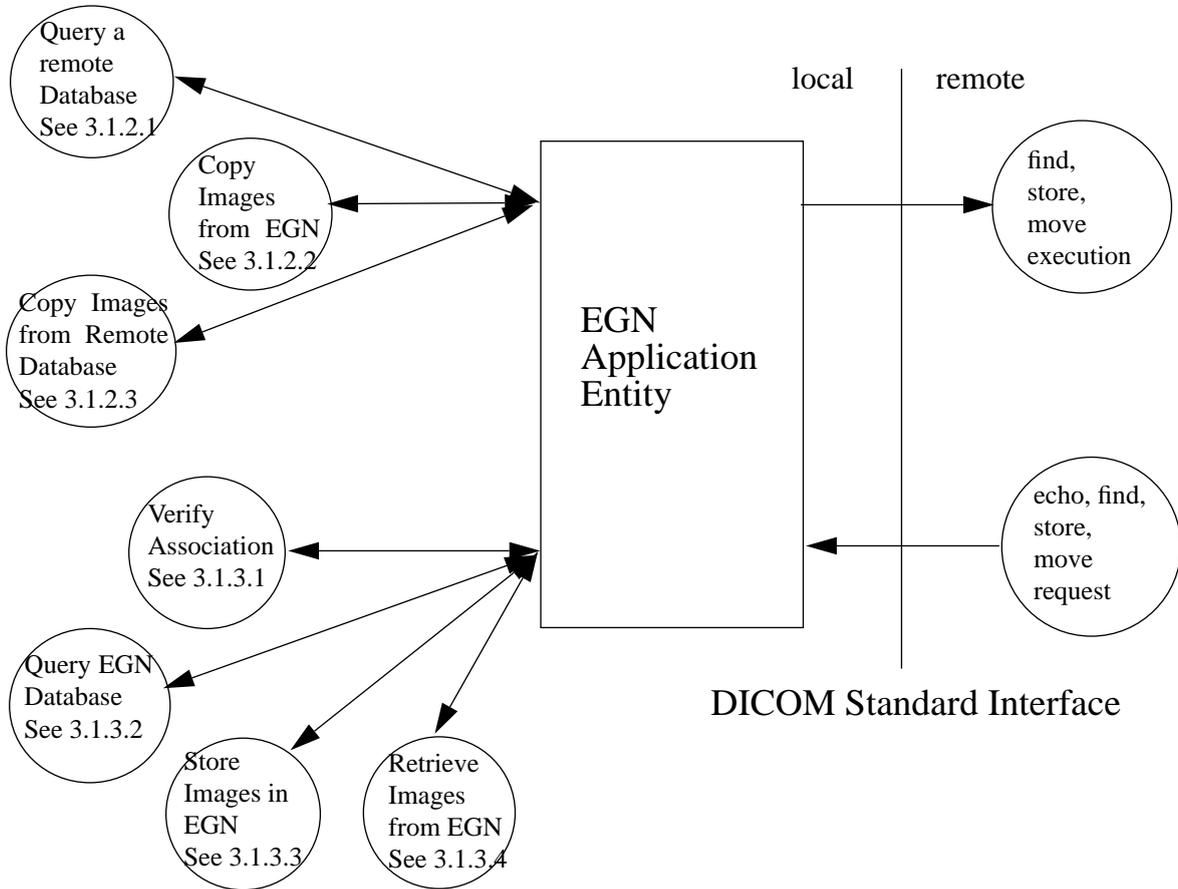
3 AE Specifications

3.1 AE EGN Specification

The EGN Application Entity provides Standard Conformance to the following DICOM V3.0
SOP classes as an SCU:

Table 1: Supported SOP classes by the EGN AE as SCU[a]

SOP class Name	UID
Patient Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Study Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Patient/Study Only Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.3.1
Patient Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
CR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.1
CT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.2
MR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.4
NM Image Storage - STORE (**old class**)	1.2.840.10008.5.1.4.1.1.5
US Image Storage - STORE (**old class**)	1.2.840.10008.5.1.4.1.1.6
SC Image Storage - STORE	1.2.840.10008.5.1.4.1.1.7
XA Single-Plane Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.2

  a. In case the remote system does not support the XA and/or RF Image SOP Class, EGN will convert
      these images and sends them via the SC Image SOP Class.

The EGN Application Entity provides Standard Conformance to the following DICOM V3.0
SOP classes as an SCP:

Table 2: Supported SOP classes by the EGN AE as SCP

SOP class Name	UID
Patient Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Study Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.2.1
Patient/Study Only Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.3.1

Table 2: Supported SOP classes by the EGN AE as SCP (Continued)

SOP class Name	UID
Patient Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
Study Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2
Patient/Study Only Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.3.2
CR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.1
CT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.2
US Multi Frame Image Storage - STORE (**old class**)	1.2.840.10008.5.1.4.1.1.3
MR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.4
NM Image Storage - STORE (**old class**)	1.2.840.10008.5.1.4.1.1.5
US Image Storage - STORE (**old class**)	1.2.840.10008.5.1.4.1.1.6
SC Image Storage - STORE	1.2.840.10008.5.1.4.1.1.7
XA Single-Plane Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.1
RF Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.2
XA Bi-Plane Image Storage - STORE	1.2.840.10008.5.1.4.1.1.12.3
Verification	1.2.840.10008.1.1

3.1.1 Association Establishment Policies

3.1.1.1 General

EGN will offer unrestricted PDU size (i.e. equal to 0) on associations initiated by EGN itself.
This is also configurable.
EGN will accept any PDU size offered on associations initiated by remote applications.

3.1.1.2 Number of Associations

The number of simultaneous associations supported by EGN as a Service Class Provider
(SCP) is in principle not limited. The practical maximum number of supported associations is
determined by the amount of resources (CPU, memory, hard disk size).
As a result of local activities, EGN will initiate as Service Class User (SCU) at most 2 simulta-
neous associations. One association is used to issue FIND requests. The other association is
used to issue STORE and MOVE requests.
EGN will further initiate an association for each remote MOVE request executed by EGN.
These associations are used to issue the STORE suboperations implied by the MOVE requests.
The number of simultaneous STORE associations is in principle not limited.

3.1.1.3 Asynchronous Nature

EGN does not support asynchronous operations and will not perform asynchronous window negotiation.

3.1.1.4 Implementation Identifying Information

The Implementation Class UID is: 1.3.46.670589.5.2.5
The implementation version name is: EGN1.1

3.1.2 Association Initiation Policy

EGN initiates associations as a result of the following events:
• The EGN operator queries a remote database.
• The EGN operator or a remote application copies images from the EGN database to another database.
• The EGN operator copies images from a remote database to another database.

3.1.2.1 Query a Remote Database

3.1.2.1.1   Associated Real-World Activity

The operator queries a remote database by means of the query tool in the EGN data handling facility. EGN initiates an association to the selected peer entity and uses it to send FIND requests (and receive the associated FIND replies). The association is released when the FIND execution completes.

3.1.2.1.2   Proposed Presentation Contexts

EGN will propose the following presentation contexts:

Table 3: Proposed Presentation Contexts for Remote Database Query

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
See Note	See Note	JPEG Lossless, Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None

Note: Any of the FIND SOP classes listed in Table 1, "Supported SOP classes by the EGN AE as SCU," on page 5.

3.1.2.1.3   C-FIND SCU Conformance

EGN will not generate queries containing optional keys. EGN will not generate relational queries.

3.1.2.2 Copy Images from the EGN Database to another Database

3.1.2.2.1   Associated Real-World Activity

The operator copies a (part of a) study from the local EGN database to a another database by means of the copy tool in the EGN data handling facility. EGN initiates for each selected study an association to the selected peer entity and uses it to send C-STORE requests (and receive the associated STORE replies). The association is released when all selected images in the selected study have been transmitted. EGN handles operator copy requests one after another. A remote application copies images from the local EGN database to a another database by sending a C-MOVE request to EGN. EGN initiates for each received MOVE request an association to the requested MOVE destination and uses it to send C-STORE requests (and receive the associated STORE replies). The association is released when all images selected by the MOVE request identifier have been transmitted. EGN simultaneously handles simultaneous C-MOVE requests.

3.1.2.2.2   Proposed Presentation Contexts

EGN will propose the following presentation contexts:

Table 4: Proposed Presentation Contexts for Copy EGN to Other

Presentation Context table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
See Note	See Note	JPEG Lossless, Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None

Note: Any of the STORE SOP classes listed in Table 1, "Supported SOP classes by the EGN AE as SCU," on page 5.

3.1.2.2.3   C-STORE SCU Conformance

EGN will stop the transfer of the images and release the association as soon as it receives an unsuccessful or warning STORE response status. If the EGN operator requested the transfer, the STORE response status is displayed via the user interface of EGN. If a remote application requested the transfer (by means of a C-MOVE request), a MOVE response with status unsuccessful is sent to the MOVE requester.

Extended negotiation is not supported.

In case the remote system does not support the XA and/or RF Image SOP Class, EGN will convert these images and sends them via the SC Image SOP Class.

The transmitted Storage SOP instances may include all optional elements specified in the standard and its supplements 4 and 6.
The transmitted Storage SOP instances contain retired and private data elements. Private elements are not described except for the following elements that facilitate the correct interpretation of the pixel data of images exported by EGN:

- *odd group number, 00YY Owner Data Elements (VR=LO, VM=1)*
  The value of this text element is 'SPI-P Release 1'. It declares that all elements YYxx in the shadow group are private Philips elements.

- *0009, YY04 Image Data Consistence (VR=LO, VM=n)*
  This element indicates that the consistency of some data elements may be limited because of incorporated processing, windowing or burnt in graphics. A data element becomes inconsistent if its value incorporates a value (or reference to a value) which has been changed while the data element itself has not been changed or deleted. Updating or deleting such data elements cannot be done if the data element is a free formatted data element or other than a standard data element. The generic format of this text element is: <free text> | '$'<enumerated text>. The following enumerations are defined:
  - 'unknown'. This is the default value.
  - 'normal'. Normal consistency.
  - 'limited'. Possibly limited consistency.

- *0019, YY25 Original Pixel Data Quality (VR=LO, VM=n)*
  This element indicates that the quality of the original pixel data is limited because of one reason or another. The generic format of this text element is: <free text> | '$'<enumerated text>. The following enumerations are defined:
  - 'unknown'. This is the default value.
  - 'normal'. Normal quality, as usual for the modality.
  - 'limited'. Possibly limited quality.

- *0029, YY25 Processed Pixel Data Quality (VR=LO, VM=n)*
  This element indicates that the quality of the processed pixel data is limited because of incorporated processing, windowing or burnt in graphics. The first value summarizes the quality. Each subsequent value identifies one aspects which contributes to the quality, in order of occurrence. The generic format of this text element is: <free text> | '$'<enumerated text>. The following enumerations are defined:
  - 'unknown'. This is the default value.
  - 'normal'. Normal quality, as usual for the modality.
  - 'limited'. Possibly limited quality.

3.1.2.3 Copy Images from a Remote Database to another Database

3.1.2.3.1   Associated Real-World Activity

The operator copies a (part of a) study from a remote database to another, local or remote, data-

base by means of the copy tool in the EGN data handling facility. EGN initiates for each selected study an association to the selected peer entity and uses it to send C-MOVE requests (and receive the associated MOVE replies). The association is released when all selected images in the selected study have been transmitted.

3.1.2.3.2   Proposed Presentation Contexts

EGN will propose the following presentation contexts:

Table 5: Proposed Presentation Contexts for Copy Remote to Other

Presentation Context table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
See Note	See Note	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note	See Note	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None
See Note	See Note	JPEG Lossless, Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None

Note: Any of the MOVE SOP classes listed in Table 1, "Supported SOP classes by the EGN AE as SCU," on page 5.

3.1.2.3.3   C-MOVE SCU Conformance

The AE provides standard conformance.

3.1.3 Association Acceptance Policy

The EGN Application Entity rejects association requests from unknown applications, i.e. applications that offer an unknown "calling AE title". An application is known if and only if it is defined during configuration of the EGN system.

The EGN Application Entity rejects association requests from applications that do not address the EGN AE, i.e. that offer a wrong "called AE title". The EGN AE title is defined during configuration of the EGN system.

EGN accepts associations for the following purposes:

• To allow remote applications to verify application level communication with EGN.
• To allow remote applications to query the EGN database.
• To allow remote applications to store images in the EGN database.
• To allow remote applications to retrieve images from the EGN database.

Any of the presentation contexts shown in the table below are acceptable:

Table 6: Acceptable Presentation Contexts

Presentation Context table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
See Note	See Note	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
See Note	See Note	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
See Note	See Note	JPEG Lossless, Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None

Note: Any of the SOP classes listed in Table 2, "Supported SOP classes by the EGN AE as SCP," on page 5.

3.1.3.1 Verify Application Level Communication

3.1.3.1.1   Associated Real-World Activity

EGN accepts associations from nodes that wish to verify application level communication using the C-ECHO command.

3.1.3.1.2   Presentation Context Table

Any of the presentation contexts shown in Table 6, "Acceptable Presentation Contexts," on page 11 are acceptable.

3.1.3.1.3   C-ECHO SCP Conformance

EGN provides standard conformance.

3.1.3.1.4   Presentation Context Acceptance Criterion

EGN accepts all contexts in the intersection of the proposed and acceptable presentation contexts. There is no check for duplicate contexts. Duplicate contexts are accepted.

3.1.3.1.5   Transfer Syntax Selection Policies

EGN prefers Explicit VR Big Endian above Explicit VR Little Endian above JPEG Lossless above Implicit VR transfer syntax.

3.1.3.2 Query the EGN Database

3.1.3.2.1   Associated Real-World Activity

EGN accepts associations from nodes that wish to query the EGN database using the C-FIND

command.

3.1.3.2.2   Presentation Context Table

Any of the presentation contexts shown in Table 6, "Acceptable Presentation Contexts," on page 11 are acceptable.

3.1.3.2.3   C-FIND SCP Conformance

EGN provides standard conformance. Optional keys are not supported. Relational queries are not supported. EGN simultaneously handles simultaneous C-FIND requests.

3.1.3.2.4   Presentation Context Acceptance Criterion

See chapter 3.1.3.1.4 on page 11.

3.1.3.2.5   Transfer Syntax Selection Policies

See chapter 3.1.3.1.5 on page 11.

3.1.3.3 Store Images in the EGN Database

3.1.3.3.1   Associated Real-World Activity

EGN accepts associations from nodes that wish to store images in the EGN database using the C-STORE command.

3.1.3.3.2   Presentation Context Table

Any of the presentation contexts shown in Table 6, "Acceptable Presentation Contexts," on page 11 are acceptable.

3.1.3.3.3   C-STORE SCP Conformance

EGN provides level 2 (Full) conformance for the Storage Service Class. In the event of a successful C-STORE operation, the image has been stored in the EGN database. The duration of the storage of the image is determined by the operator of the EGN system.

The EGN storage implementation has the following restrictions:
* Although EGN accepts colour images, it does not properly support storage and retrieval of such images.
* EGN stores XA Bi-Plane as two Single Plane images.
* EGN stores multi-frame images as a series of single frame images.

EGN allows the operator to modify attributes of the stored images. EGN does not modify the pixel values of the stored images. Modified images retain their original study, series and image UID. Remote applications may access the stored (and possibly modified) images using C-FIND and/or C-MOVE operations.

EGN stores all private data elements it receives. These elements can only be retrieved (by means of a C-MOVE request) if the following condition is satisfied:
* The image was encoded (when EGN was C-STORE SCP) using one of the explicit value representations or

- The image was encoded (when EGN was C-STORE SCP) using implicit value representation and the MOVE destination (i.e. a C-STORE service class provider) has accepted implicit value representation as the only transfer syntax applicable to the storage SOP class of the image (when EGN is C-STORE SCU).

The Mandatory (type 1) attributes in the received CT and MR images are required to perform the EGN application functions. However, in order to perform these functions, there should be a well defined relation between the values of these Mandatory DICOM attributes. This value relation is forced by the applied CT / MR scanning protocol, described in the operators' manual of the EasyGuide Neuro system.

The C-STORE is unsuccessful if EGN returns one of the following status codes:
- A700 - Indicates the database is full or that the image is larger than 4 Mb. Recovery from this condition is left to the service class user.
- A900 - Indicates that the SOP class of the image does not match the abstract syntax negotiated for the presentation context.
- C000 - Indicates that the image cannot be parsed.

3.1.3.3.4   Presentation Context Acceptance Criterion

See chapter 3.1.3.1.4 on page 11.

3.1.3.3.5   Transfer Syntax Selection Policies

See chapter 3.1.3.1.5 on page 11.

3.1.3.4 Retrieve Images from the EGN Database

3.1.3.4.1   Associated Real-World Activity

EGN accepts associations from nodes that wish to retrieve images from the EGN database using the C-MOVE command.

3.1.3.4.2   Presentation Context Table

Any of the presentation contexts shown in Table 6, "Acceptable Presentation Contexts," on page 11 are acceptable.

3.1.3.4.3   C-MOVE SCP Conformance

EGN supports all the Storage SOP classes listed in Table 2, "Supported SOP classes by the EGN AE as SCP," on page 5.

3.1.3.4.4   Presentation Context Acceptance Criterion

See chapter 3.1.3.1.4 on page 11.

3.1.3.4.5   Transfer Syntax Selection Policies

See chapter 3.1.3.1.5 on page 11.

4 Communication Profiles

4.1 Supported Communication Stacks

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

4.2 TCP/IP Stack

EGN inherits its TCP/IP stack from the SUN Solaris system upon which it executes.

4.2.1 Physical Media Support

Ethernet ISO.8802-3. Standard AUI, optional twisted pair 10-BaseT.

5 Extensions/Specializations/Privatizations

Not applicable.

6 Configuration

The EGN system is configured by means of a configuration program. This program is accessible at start-up of the EGN system. It is password protected and intended to be used by Philips service engineers only. The program prompts the service engineer to enter configuration information needed by the EGN application.

6.1 AE Title/Presentation Address mapping

6.1.1 Local AE Titles and Presentation Addresses

The EGN AE title is equal to the IP host name. This host name is to be entered by the service engineer at EGN configuration time.
EGN listens on port 3010. This port number is not configurable.

6.1.2 Remote AE Titles and Presentation Addresses

All remote applications that wish to communicate with EGN must be defined at EGN configuration time. The service engineer must provide the following information for each remote application:
• The application entity title.
For remote applications that act as service class provider the following additional information must be provided:
• The host name on which the application resides.
• The port number at which the application accepts association requests.
• The SOP classes for which the application provides conformance as an SCP.

6.2 Configurable parameters

The maximum PDU size for associations initiated by EGN is configurable.

7 Support of Extended Character Sets

EGN supports Extended Character Set "ISO_IR 100" which is the Latin alphabet No 1, supplementary set.