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**Candelis Technology Inc.
DICOM Conformance Statement**

**ImageGrid
Storage Server**

0 INTRODUCTION

ImageGrid is a complete hardware/software, turnkey image archive solution a web based system management GUI. It contains Candelis' DICOM server application software that provides services of image storage, query of image attributes, and retrieval of images to peer DICOM 3.0 compliant application entities.

ImageGrid supports access restriction rules to limit read/write access to specified application entities. In addition, it supports secure socket layer for secure network communication, and syslog-based auditing.

1 IMPLEMENTATION MODEL

ImageGrid server runs as a daemon process, acting as multiple Application Entities that support DICOM Service Class Provider (SCP) for Storage, Query/Retrieve, Verification, and Storage Commit operations. ImageGrid waits for external requests for association from peer DICOM compliant application entity, and establishes the connection for storing, querying, and retrieving images, after verifying the peer's access privilege successfully.

Using ImageGrid's system management web GUI, application entity titles of its peer application entities and other configurable parameters can be configured.

1.1 ImageGrid Application Data Flow Diagram

Figure 1.1 shows how ImageGrid interacts with real world activities.

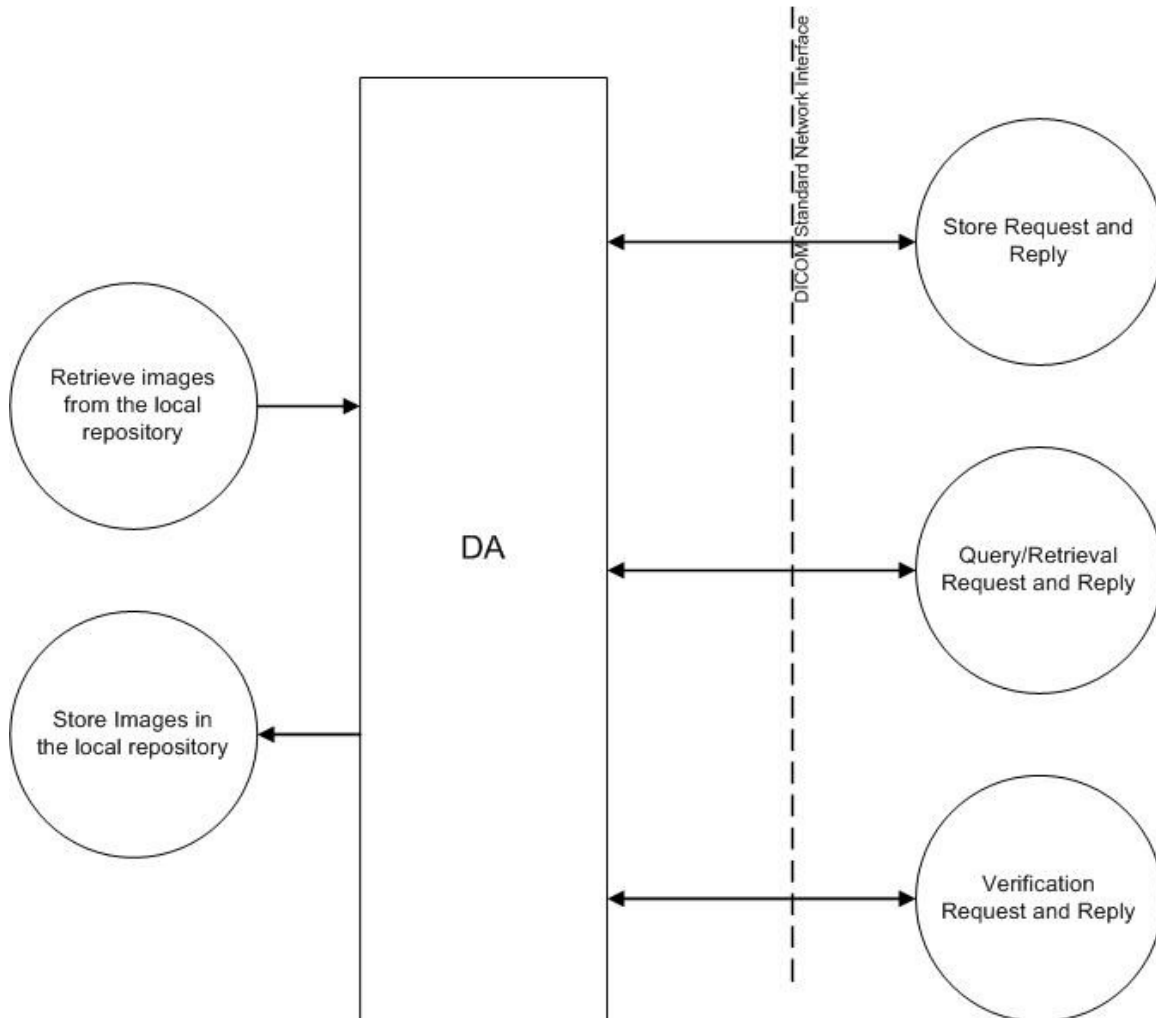


Figure 1-1: ImageGrid Implementation Model

1.2 Functional Definitions of AE's

ImageGrid waits for another application entity to connect at the presentation address configured for its Application Entity Title. ImageGrid will accept associations with Presentation Contexts for SOP Classes of the Storage and Query/Retrieve Service Classes.

1.3 Sequencing of Real-World Activities

Real world activities, as depicted in figure 1-1, may take place independent of each other and there are no sequencing constraints.

2 AE Specifications

The ImageGrid daemon can be configured to act as multiple Application Entities, all configurable through the web GUI. ImageGrid will spawn a new copy of itself for each new connection. Many instances of ImageGrid may represent the same Application Entity.

2.1 ImageGrid Specification

ImageGrid provides standard conformance to the following DICOM V3.0 SOP Classes as an SCP:

Table 2.1: SOP Class Name SOP Class UID

SOP Class Name	SOP Class ID
VerificationSOPClass	1.2.840.10008.1.1
StoredPrintStorage	1.2.840.10008.5.1.1.27
HardcopyGrayscaleImageStorage	1.2.840.10008.5.1.1.29
HardcopyColorImageStorage	1.2.840.10008.5.1.1.30
ComputedRadiographyImageStorage	1.2.840.10008.5.1.4.1.1.1
DigitalXRayImageStorageForPresentation	1.2.840.10008.5.1.4.1.1.1.1
DigitalXRayImageStorageForProcessing	1.2.840.10008.5.1.4.1.1.1.1.1
DigitalMammographyXRayImageStorageForPresentation	1.2.840.10008.5.1.4.1.1.1.2
DigitalMammographyXRayImageStorageForProcessing	1.2.840.10008.5.1.4.1.1.1.2.1
DigitalIntraOralXRayImageStorageForPresentation	1.2.840.10008.5.1.4.1.1.1.3
DigitalIntraOralXRayImageStorageForProcessing	1.2.840.10008.5.1.4.1.1.1.3.1
CTImageStorage	1.2.840.10008.5.1.4.1.1.2
UltrasoundMultiframeImageStorage	1.2.840.10008.5.1.4.1.1.3.1
MRImageStorage	1.2.840.10008.5.1.4.1.1.4
EnhancedMRImageStorage	1.2.840.10008.5.1.4.1.1.4.1
MRSpectroscopyStorage	1.2.840.10008.5.1.4.1.1.4.2
UltrasoundImageStorage	1.2.840.10008.5.1.4.1.1.6.1
SecondaryCaptureImageStorage	1.2.840.10008.5.1.4.1.1.7
MultiframeSingleBitSecondaryCaptureImageStorage	1.2.840.10008.5.1.4.1.1.7.1
MultiframeGrayscaleByteSecondaryCaptureImageStorage	1.2.840.10008.5.1.4.1.1.7.2
MultiframeGrayscaleWordSecondaryCaptureImageStorage	1.2.840.10008.5.1.4.1.1.7.3
MultiframeTrueColorSecondaryCaptureImageStorage	1.2.840.10008.5.1.4.1.1.7.4
StandaloneOverlayStorage	1.2.840.10008.5.1.4.1.1.8
StandaloneCurveStorage	1.2.840.10008.5.1.4.1.1.9
TwelveLeadECGWaveformStorage	1.2.840.10008.5.1.4.1.1.9.1.1
GeneralECGWaveformStorage	1.2.840.10008.5.1.4.1.1.9.1.2
AmbulatoryECGWaveformStorage	1.2.840.10008.5.1.4.1.1.9.1.3
HemodynamicWaveformStorage	1.2.840.10008.5.1.4.1.1.9.2.1
CardiacElectrophysiologyWaveformStorage	1.2.840.10008.5.1.4.1.1.9.3.1
BasicVoiceAudioWaveformStorage	1.2.840.10008.5.1.4.1.1.9.4.1
StandaloneModalityLUTStorage	1.2.840.10008.5.1.4.1.1.10
StandaloneVOILUTStorage	1.2.840.10008.5.1.4.1.1.11
GrayscaleSoftcopyPresentationStateStorage	1.2.840.10008.5.1.4.1.1.11.1
XRayAngiographicImageStorage	1.2.840.10008.5.1.4.1.1.12.1
XRayFluoroscopyImageStorage	1.2.840.10008.5.1.4.1.1.12.2
NuclearMedicineImageStorage	1.2.840.10008.5.1.4.1.1.20
RawImageGridaStorage	1.2.840.10008.5.1.4.1.1.66
VLEndoscopicImageStorage	1.2.840.10008.5.1.4.1.1.77.1.1

2.1.1 Association Establishment Policies

2.1.1.1 General

ImageGrid runs as a daemon process, listening on a configurable TCP port. Upon association request, ImageGrid checks to see if the peer application entity has the required access privilege. The maximum PDU size that ImageGrid will use is configurable through the Web GUI.

2.1.1.2 Number of Associations

The maximum number of concurrent associations for each AE is configurable through the web GUI. If not configured, the default is an unlimited number of associations. Practically, it is limited by the network bandwidth and other physical resources like memory and CPU. For each association, ImageGrid starts a separate daemon to handle that association.

2.1.1.3 Asynchronous Nature

ImageGrid does not support asynchronous operation

2.1.1.4 Implementation Identifying Information

The Implementation Class UID is 1.3.6.1.4.1.2820

The Implementation version name is "DA-PRCM-v1.0"

2.1.2 Association Acceptance Policy

Upon association request, if an external DICOM AE requests an association with ImageGrid but uses an incorrect called AE title, ImageGrid will reject the association and provide the indication of called AE title not recognized. ImageGrid then checks to see if the peer application entity has the required access privilege that the calling AE title is authorized to begin negotiations. If it is not, ImageGrid will reject the association and provide the indication of calling AE title not recognized.

2.1.3.1 Associated Real-World Activity

The Real-World Activity associated with the C-STORE operation is the storage of the image on the ImageGrid of the system upon which ImageGrid is running. ImageGrid will issue a failure status if it is unable to store the image on or if the image transferred does not conform to the IOD of the SOP class under which it was transmitted.

2.1.3.2 Transfer Syntax Table

ImageGrid supports the following transfer syntaxes for all the SOP classes mentioned in table 2.1.

Table 2-2 Supported Presentation Contexts

Name	UID
LittleEndianImplicitTransferSyntax	1.2.840.10008.1.2
LittleEndianExplicitTransferSyntax	1.2.840.10008.1.2.1
BigEndianExplicitTransferSyntax	1.2.840.10008.1.2.2
JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50
JPEG Extended (Process 2 & 4)	1.2.840.10008.1.2.4.51
JPEG Spectral Selection, NH (Process 6 & 8)	1.2.840.10008.1.2.4.53
JPEG Full Progression, NH (Process 10 & 12)	1.2.840.10008.1.2.4.55
JPEG Lossless, NH (Process 14)	1.2.840.10008.1.2.4.57
JPEG Lossless, NH, FOP (Process 14 SV1)	1.2.840.10008.1.2.4.70
RLE Lossless0	1.2.840.10008.1.2.5

2.1.3.3 SOP Specific Conformance

ImageGrid conforms to the SOP's of the Storage Service Class at Level 2 (Full). No elements are discarded or coerced by it. In the event of a successful C-STORE operation, the Image has successfully been written to ImageGrid and a return code of 0000 will be returned. Following are the return codes for specific SOPs:

2.1.3.3.1 Store Return Codes:

Status Code	Reason	Status Category
A700	Out of Resources; indicates that there was not enough ImageGrid space to store the image.	Failure
A800	SOP Class is not Supported	Failure
A900	ImageGrid set does not match SOP Class	Failure
C000	ImageGrid set can't be parsed into its elements	Failure
B000	Coercion of ImageGrid elements	Warning
B007	ImageGrid Set does not match SOP Class	Warning
B006	Element ImageGrid carded	Warning

2.1.3.3.2 Find Specific Codes:

Status Code	Reason	Status Category
A700	Out of Resources; indicates that there was not enough ImageGrid space to store the image.	Failure
A800	SOP Class is not supported	Failure
A900	ImageGrid set does not match SOP Class	Failure
FE00	Matching terminated due to cancel request	Canceled
FF01	Unsupported optional keys	Warning

2.1.3.3.3 Move Specific Codes:

Status Code	Reason	Status Category
A701	Out of Resources; NUMBER OF MATCHES	Failure
A702	Out of Resources; SUB OPERATIONS	Failure
A800	SOP Class is not Supported	Failure
A801	Move Destination Unknown	Failure
A900	ImageGrid set does not match SOP Class	Failure
C000	Unable to Process	Failure
FE00	Matching terminated due to cancel request	Canceled
B000	Coercion of ImageGrid elements	Warning

2.1.3.3.4 Get Specific Codes

Status Code	Reason	Status Category
A701	Out of Resources; NUMBER OF MATCHES	Failure
A702	Out of Resources; SUB OPERATIONS	Failure
A800	SOP Class is not Supported	Failure
A900	ImageGrid set does not match SOP Class	Failure
C000	Unable to Process	Failure
FE00	Matching terminated due to cancel request	Canceled
B000	Coercion of ImageGrid elements	Warning

2.1.3.5 Transfer Syntax Selection Policies

ImageGrid associates implicit priority with the order of offered transfer syntaxes. The transfer syntax that appears first in the list is considered to have highest priority for the negotiated party. The offered transfer syntaxes that appear in table 2-2 are accepted by ImageGrid.

ImageGrid offers the original transfer syntax of a SOP class in one presentation context followed by a second presentation context that offers standard transfer syntaxes. ImageGrid is by default configured to offer standard transfer syntaxes in the following order:

- Little Endian Explicit
- Big Endian Explicit
- Little Endian Implicit

3 COMMUNICATION PROFILES

3.1 Supported Communications Stacks (parts 8,9)

ImageGrid provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8.

3.2 TCP/IP Stack

ImageGrid uses the TCP/IP implementation of Linux kernel version 2.4.

3.2.1 Physical Media Support

ImageGrid supports 10/100/1000 BT Ethernet. It has an option of supporting Ethernet over fiber.

4 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

Not Applicable.

5 CONFIGURATION

There are two ways to configure the ImageGrid:

-Web GUI, which is the preferred method.

-LCD panel, which is used normally when network connection is not available- for example to set the IP address. LCD panel functionality is a limited subset of the Web GUI's functionality. In addition to general system parameters (like host name and IP address), the following DICOM parameters can be configured using the Web GUI:

-Configuring Global parameters

-Configuring accepted Application Entity Table (AETable)

5.1 Configurable Global Parameters

There are four global parameters that can be easily configured using the Web GUI:

5.1.1 Network TCP Port

The default Network TCP Port is set to 104. It can be configured to any port number ranging from 1 to 65535.

5.1.2 Secure TCP Port

The default Secure TCP Port is set to 3104. It can be configured to any port number ranging from 1 to 65535.

5.1.3 Max PDU Size

The maximum PDU size can be configured to 8192, 16384, 32768, or 65536 bytes. The default is 16384.

5.1.4 Max Associations

The maximum number of concurrent association is configurable. By default, there is no limit on the maximum number of associations.

5.2 Configurable Application Entity Table (AETable) Parameters

The Application Entity Table defines the local Application Entities managed by ImageGrid. Each local AE is associated with a separate storage area and defines a set of peer AE's which may communicate with the local AE. There are four AETable parameters that can be configured using the Web GUI:

5.2.1 Application Entities (AE) Title

A new AE title can be added to the list of AE titles as long as the name for the new AE title is different from all the others. It will be assigned a separate storage area. By default, the new AE title will have "ready-only" access. Its maximum studies and maximum bytes per study will both be set to unlimited. System administrators can limit the access to specific peer AEs.

5.2.2 Access Mode

"Read-only", "Write-only", "Read and Write" are the access mode options that can be selected.

5.2.3 Storage Quotas

Maximum studies and maximum bytes per study are configurable. They are set to unlimited by default.

5.2.4 Peer AEs

Each Peer AE is recognized by its own AE title, host name, and the port number used to communicate with the peer AE. A new Peer AE can be added to the list of Peer AE's as long as its three values are different from those of any existing peer AE. The port number specified for each Peer AE must not exceed 65535. The Web GUI also allows the deletion of an existing Peer AE.

6 SUPPORT OF EXTENDED CHARACTER SETS

ImageGrid does not support extended character sets.

7 References

DICOM Standard, NEMA PS 3.X-2003