OCULUS | Keratograph

DICOM CONFORMANCE STATEMENT
for Keratograph 2.3.14 (2013-03-01)

OCULUS®

CONFORMANCE STATEMENT OVERVIEW

The OCULUS Keratograph is used to measure corneal topography and is designed for use for the purpose of fitting contact lenses.

OCULUS Keratograph supports several DICOM Service Classes, using the OFFIS DICOM Toolkit (DCMTK), to provide the following capabilities:

- Query an information system for worklists of procedures to be performed (including the patient demographics).
- Send DICOM objects created by the system to a remote system.

Table 0-1 provides an overview of the network services supported by OCULUS Keratograph. The system does not support any media services.

Table 0-1: Network Services

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Encapsulated PDF Storage	Yes	No
Secondary Capture Image Storage	Yes	No
Workflow Management		
Modality Worklist Information Model – FIND	Yes	No

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1   INTRODUCTION

This DICOM Conformance Statement specifies the behavior and functionality of the OCULUS Keratograph system, with regard to supported DICOM networking SOP Classes. OCULUS Keratograph is a precision, topographical measuring instrument. It combines the keratometric measuring process with topographic mapping.

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1.1   Revision History

Document Version	Date of Issue	Author	Description
Version 2.3.14	2013-03-01	Jörg Riesmeier, Daniel Ache	Initial release of this document

1.2   Audience

This document is written for the people that need to understand how OCULUS Keratograph 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.

1.3   Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between OCULUS Keratograph 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.

1.4   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:** 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.

- **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 (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 (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.

1.5   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.

1.6   Abbreviations

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

- **ACSE:** Association Control Service Element
- **AE:** Application Entity
- **CD:** Compact Disc
- **CD-R:** Compact Disc – Recordable
- **CT:** Computer Tomography
- **DICOM:** Digital Imaging and Communications in Medicine
- **DIMSE:** DICOM Message Service Element
- **ID:** Identification / Identifier
- **IOD:** Information Object Definition
- **IPv4:** Internet Protocol version 4
- **IPv6:** Internet Protocol version 6
- **ISO:** International Standards Organization
- **JPEG:** Joint Photographic Experts Group
- **MR:** Magnetic Resonance
- **MWL:** Modality Worklist Management
- **PDF:** Portable Document Format
- **PDU:** Protocol Data Unit
- **SCP:** Service Class Provider
- **SCU:** Service Class User
- **SOP:** Service Object Pair
- **TCP/IP:** Transmission Control Protocol / Internet Protocol
- **UID:** Unique Identifier
- **VM:** Value Multiplicity
- **VR:** Value Representation

1.7   References

[DICOM] NEMA Standards Publication PS 3.1-18, Digital Imaging and Communications
in Medicine (DICOM), 2009, available at http://medical.nema.org/

2 NETWORKING

2.1 Implementation Model

2.1.1 Application Data Flow

DICOM Standard Interface
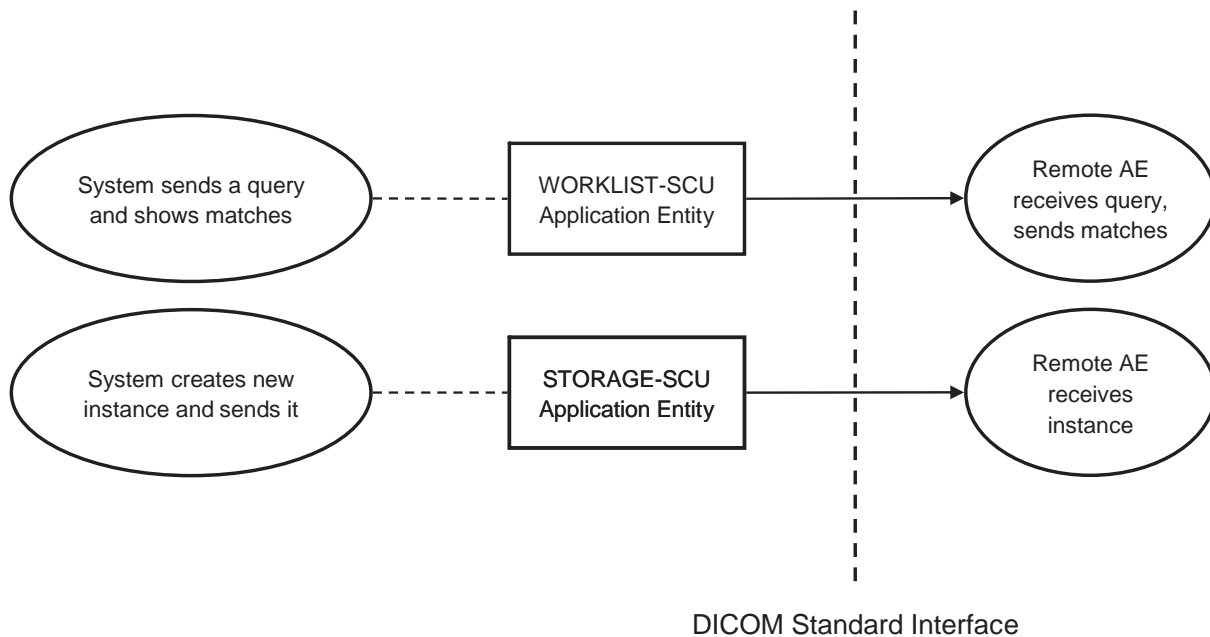
Fig. 2-1: Application Data Flow Diagram

Conceptually, the networking services which are implemented in the OCULUS Keratograph system may be modeled as the following separate AEs.

2.1.2 Functional Definitions of AEs

2.1.2.1 WORKLIST-SCU

WORKLIST-SCU is activated when the user pushes the MWL button within the patient data management. In this case, a pre-defined query is sent to a remote AE and the resulting matches are shown in the list.

2.1.2.2 STORAGE-SCU

STORAGE-SCU is activated when the user selects the DICOM menu item within the Keratograph software. In this case, a new instance of the Encapsulated PDF Storage SOP Class or Secondary Capture Image Storage SOP Class is created which is then sent to a remote AE.

2.1.3 Sequencing of Real-World Activities

All SCU activities are initiated in the user interface. For each remote AE, a new background is started which allows for multiple associations at the same time.

2.2   AE Specifications

2.2.1   WORKLIST-SCU

2.2.1.1   SOP Classes

WORKLIST-SCU provides standard conformance to the following DICOM SOP classes.

Table 2-2: SOP Classes for AE WORKLIST-SCU

SOP Class Name	SOP Class UID	SCU	SCP
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No

2.2.1.2   Association Policies

General

WORKLIST-SCU initiates but never accepts associations. The DICOM standard application context name, which is always proposed, is:

Table 2-3: DICOM Application Context for AE WORKLIST-SCU

Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size can be configured at installation time in the range 4096 to 131072 bytes. The default is 16384 bytes.
SOP Class extended negotiation is not supported.

Number of Associations

Table 2-4: Number of Associations as an Association Initiator for AE WORKLIST-SCU

Maximum number of simultaneous associations	1

Asynchronous Nature

Asynchronous mode of operation is not supported.

Implementation Identifying Information

Table 2-5: DICOM Implementation Class and Version for AE WORKLIST-SCU

Implementation Class UID	1.2.276.0.7230010.3.0.3.5.5
Implementation Version Name	OFFIS_DCMTK_355

2.2.1.3   Association Initiation Policy

WORKLIST-SCU attempts to initiate a new association for the Modality Worklist Information Model – FIND SOP Class each time the user opens the patient list and the system wants to send a query.

Activity – System sends a query and shows matches

Description and Sequencing of Activities

WORKLIST-SCU sends a query to a selected remote AE and shows the matching worklist entries (if any) in the patient list. For each query to be performed, a single attempt will be made. If the send fails, no retry will be performed but an error message will be reported to the user.

Proposed Presentation Contexts

Table 2-6: Proposed Presentation Contexts for AE WORKLIST-SCU and Real-World Activity 'System Sends a query and Shows Matches'

Presentation Context Table					
Abstract Syntax		**Transfer Syntax**		**Role**	**Ext. Neg.**
Name	**UID**	**Name List**	**UID List**		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	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

Extended Negotiation

No extended negotiation is performed.

SOP Specific Conformance to Modality Worklist SOP Class

WORKLIST-SCU provides standard conformance to the Modality Worklist Information Model – FIND SOP Class as an SCU.

Unexpected attributes returned in a C-FIND response are ignored in the same manner as requested (optional) return attributes not returned by the SCP. Non-matching responses returned by the SCP due to unsupported matching keys are not filtered locally by the WORKLIST-SCU and thus will still be shown in the patient list. No attempt is made to filter out duplicate responses.

No cancel requests are ever issued.

Specific Character Set (0008,0005) will never be included in the query. If present in the response, its element value will be used to identify character sets other than the default character set for display. Please note, however, that only ISO_IR 100 (ISO 8859-1, Latin 1) is supported (see section 4). If another specific character set is specified, the worklist entry will not be shown to the user but a message will be reported to the service logs.

The WORKLIST-SCU application entity uses the following attributes from the Modality Worklist Information Model.

Table 2-7: Request Identifiers for AE WORKLIST-SCU

Attribute	Tag	Types of Matching
Accession Number	(0008,0050)	Universal Matching
Referring Physician's Name	(0008,0090)	Universal Matching
Patient's Name	(0010,0010)	Universal Matching
Patient ID	(0010,0020)	Universal Matching
Patient's Birth Date	(0010,0030)	Universal Matching
Patient's Sex	(0010,0040)	Universal Matching
Study Instance UID	(0020,000D)	Universal Matching
Requesting Physician	(0032,1032)	Universal Matching
Requested Procedure Description	(0032,1060)	Universal Matching
Scheduled Procedure Step Sequence	(0040,0100)	Universal Matching
>Modality	(0008,0060)	Universal Matching
>Requested Contrast Agent	(0032,1070)	Universal Matching
>Scheduled Station AE Title	(0040,0001)	Single Value Matching
>Scheduled Procedure Step Start Date	(0040,0002)	Single Value Matching
>Scheduled Procedure Step Start Time	(0040,0003)	Universal Matching
>Scheduled Performing Physician's Name	(0040,0006)	Universal Matching
>Scheduled Procedure Step Description	(0040,0007)	Universal Matching
>Scheduled Procedure Step ID	(0040,0009)	Universal Matching
>Scheduled Station Name	(0040,0010)	Universal Matching
>Scheduled Procedure Step Location	(0040,0011)	Universal Matching
>Pre-Medication	(0040,0012)	Universal Matching
>Comments On The Scheduled Procedure Step	(0040,0400)	Universal Matching
Performed Procedure Step ID	(0040,0253)	Universal Matching

Further attributes can be added by changing the configuration of WORKLIST-SCU.

Presentation Context Acceptance Criterion

WORKLIST-SCU does not accept associations.

Transfer Syntax Selection Policies

If offered a choice of transfer syntaxes in the accepted presentation contexts, the default behavior of WORKLIST-SCU is to prefer the explicit VR transfer syntax with the byte order matching the local machine byte order, i. e. little endian on a Windows PC. If this transfer syntax is not available, the explicit VR transfer syntax with opposite byte order is selected. If this is also unavailable, implicit VR little endian is selected. Finally, any matching presentation context is accepted independent of the transfer syntax.

The default behavior may be modified by changing the configuration of WORKLIST-SCU.

Response Status

WORKLIST-SCU will behave as described in the table below when receiving the C-FIND response command message.

Table 2-8: Response Status Handling Behavior for AE WORKLIST-SCU and Real-World Activity 'Sysytem Sends a Query and Shows Matches'

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A7xx	This is treated as a permanent failure.
Error	Identifier does not match SOP class	A9xx	This is treated as a permanent failure.
	Unable to process	Cxxx	This is treated as a permanent failure.
Cancel	Matching terminated due to cancel request	FE00	Should never occur since cancel requests are never issued.
Success	Matching is complete – No final identifier is supplied	0000	Current query is completed successfully; resulting list of worklist entries is presented to the user.
Pending	Matches are continuing – Current match is supplied and any optional keys were supported in the same manner as required keys	FF00	Current match is added to the internal list of worklist entries but not yet presented to the user.
	Matches are continuing – Warning that one or more optional keys were not supported for existence and/or matching for this identifier	FF01	Current match is added to the internal list of worklist entries but not yet presented to the user.

Table 2-9: Communication Failure Behavior for AE WORKLIST-SCU and Real-World Activity 'System Sends a Query and Shows Matches'

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
ASCE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
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 reported to both the service logs and to the user interface.

2.2.1.4 Association Acceptance Policy

WORKLIST-SCU does not accept associations.

2.2.2 STORAGE-SCU

2.2.2.1 SOP Classes

STORAGE-SCU provides standard conformance to the following DICOM SOP classes.

Table 2-10: SOP Classes for AE STORAGE-SCU

SOP Class Name	SOP Class UID	SCU	SCP
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	No
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes	No

2.2.2.2 Association Policies

General

STORAGE-SCU initiates but never accepts associations. The DICOM standard application context name, which is always proposed, is:

Table 2-11: DICOM Applictaion Context for AE STORAGE-SCU

Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size can be configured at installation time in the range 4096 to 131072 bytes. The default is 16384 bytes.

SOP Class extended negotiation is not supported.

Number of Associations

Table 2-12: Number of Associations as an Associations Initiator for AE STORAGE-SCU

Maximum number of simultaneous associations	1

Asynchronous Nature

Asynchronous mode of operation is not supported.

Implementation Identifying Information

Table 2-13: DICOM Implementation Class and Version for AE STORAGE-SCU

Implementation Class UID	1.2.276.0.7230010.3.0.3.5.5
Implementation Version Name	OFFIS_DCMTK_355

2.2.2.3 Association Initiation Policy

STORAGE-SCU attempts to initiate a new association each time the system creates an instance and wants to send it.

Activity – System creates new instance and sends it

Description and Sequencing of Activities

STORAGE-SCU sends a newly created instance to a selected remote AE. For each instance to be transferred, a single attempt will be made. If the send fails, no retry will be performed but an error message will be reported to the service logs.

Proposed Presentation Contexts

Table 2-14: Proposed Presentation Contexts for AE STORAGE-SCU and Real-World Activity 'System Creates New Instance and Sends It'

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	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
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Baseline (P1)	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.50		

Extended Negotiation

No extended negotiation is performed.

SOP Specific Conformance

SOP Specific Conformance to Storage SOP Classes

STORAGE-SCU provides standard conformance to the Storage Service Class as an SCU.

Presentation Context Acceptance Criterion

STORAGE-SCU does not accept associations.

Transfer Syntax Selection Policies

If offered a choice of transfer syntaxes in the accepted presentation contexts, the default behavior of STORAGE-SCU is to prefer the transfer syntax that is used for the DICOM file stored on the local system. If this transfer syntax is not available, an explicit VR uncompressed transfer syntax is selected. If this is also unavailable, implicit VR little endian is selected. Finally, any matching presentation context is accepted independent of the transfer syntax.

The default behavior may be modified by changing the configuration of STORAGE-SCU.

Response Status

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

Table 2-15: Response Status Handling Behavior for AE STORAGE-SCU and Real-World Activity 'System Creates New Instance and Sends It'

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A7xx	This is treated as a permanent failure. An error message is reported to the service logs. No message is posted to the user interface.
Error	Data set does not match SOP class	A9xx	This is treated as a permanent failure. An error message is reported to the service logs. No message is posted to the user interface.
	Cannot understand	Cxxx	This is treated as a permanent failure. An error message is reported to the service logs. No message is posted to the user interface.
Warning		Bxxx	Transmission of the DICOM instance is considered successful. A warning message is output to the service logs. No message is posted to the user interface.
Success		0000	The DICOM instance was successfully received by the remote AE. No message is reported to the service logs or posted to the user interface.

Table 2-16: Communication Failure Behavior for AE STORAGE-SCU and Real-World Activity 'System Creates New Instance and Sends It'

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is reported to the service logs. No message is posted to the user interface.
ASCE response message could not be received within the specified time range (configurable parameter).	An error message is reported to the service logs. No message is posted to the user interface.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is reported to the service logs. No message is posted to the user interface.
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 reported to the service logs. No message is posted to the user interface.

2.2.2.4 Association Acceptance Policy

STORAGE-SCU does not accept associations.

2.3 Physical Network Interfaces

2.3.1 Physical Network Interface

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

2.3.2 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.

2.3.3 IPv4 and IPv6 Support

OCULUS Keratograph only supports IPv4 connections.

2.4 Configuration

The configuration can be changed by the user in the preferences dialog. Details are described in the document "OCULUS DICOM configuration howto".

2.4.1 AE Title / Presentation Address Mapping

The Calling AE Title of the local AEs is configurable in the preferences dialog and the device's configuration file ("dicom.ini"). The mapping of the logical name by which remote AEs are described in the user interface to Called AE Titles as well as presentation address (hostname or IP address and port number) is configurable in the preferences dialog and the configuration file.

2.4.1.1 Local AE Titles

Table 2-17: AE Title Configuration Table

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

4.4.1.2 Remote AE Titles

The AE Title, host name or IP address, and port number of remote AEs are configured in the preferences dialog.

4.4.2 Configurable Parameters

Concerning the WORKLIST-SCU application entity, the following parameters are configurable.

Table 2-18: Configurable Parameters for AE WORKLIST-SCU

Parameter	Configurable	Default Value
Time-out waiting for response to TCP/IP connect request	Yes	unlimited
Time-out for ACSE messages	Yes	30 seconds
Time-out for DIMSE messages	Yes	unlimited
Maximum PDU size the AE can receive	Yes	16384 bytes

Concerning the STORAGE-SCU application entity, the following parameters are configurable..

Table 2-19: Configurable Parameters for AE STORAGE-SCU

Parameter	Configurable	Default Value
Time-out waiting for response to TCP/IP connect request	Yes	unlimited
Time-out for ACSE messages	Yes	30 seconds
Time-out for DIMSE messages	Yes	unlimited
Maximum PDU size the AE can receive	Yes	16384 bytes

3   MEDIA STORAGE

OCULUS Keratograph does not support any media services.

4   SUPPORT OF EXTENDED CHARACTER SETS

OCULUS Keratograph supports the ISO_IR 100 (ISO 8859-1, Latin 1) extended character set for the WORKLIST-SCU and for the created SOP instances.

5   SECURITY

5.1   Security Profiles

OCULUS Keratograph does not support any security profiles.

5.2   Association Level Security

OCULUS Keratograph does not support any association level security.

5.3   Application Level Security

OCULUS Keratograph does not support any application level security.

6 ANNEXES

6.1 IOD Contents

6.1.1 Created SOP Instances

6.1.1.1 Encapsulated PDF IOD

OCULUS Keratograph creates Encapsulated PDF IOD objects containing a screenshot of the presented examination view. 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 6-1: Encapsulated PDF IOD Modules

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6-3	Always
	Clinical Trial Subject	–	Never
Study	General Study	Table 6-4	Always
	Patient Study	–	Never
	Clinical Trial Subject	–	Never
Series	Encapsulated Document Series	Table 6-8	Always
	Clinical Trial Subject	–	Never
Equipment	General Equipment	Table 6-5	Always
	SC Equipment	Table 6-6	Always
Encapsulated Document	Encapsulated Document	Table 6-9	Always
	SOP Common	Table 6-10	Always
	Private Data	Table 6-7	Not always

6.1.1.2   Secondary Capture Image IOD

OCULUS Keratograph creates Secondary Capture Image IOD objects containing a screen-shot of the presented examination view. 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 6-2: Secondary Capture Image IOD Modules

IE	Module	Reference	Presence of Module
Patient	Patient	Table 6-3	Always
	Clinical Trial Subject	–	Never
Study	General Study	Table 6-4	Always
	Patient Study	–	Never
	Clinical Trial Subject	–	Never
Series	General Series	Table 6-11	Always
	Clinical Trial Subject	–	Never
Equipment	General Equipment	Table 6-5	Always
	SC Equipment	Table 6-6	Always
Image	Gerneral Image	Table 6-12	Always
	Image Pixel	Table 6-13	Always
	Device	–	Never
	Specimen	–	Never
	SC Image	–	Never
	Overlay Plane	–	Never
	Modality LUT	–	Never
	VOI LUT	–	Never
	SOP Common	Table 6-14	Always
	Private Data	Table 6-7	Not always

6.1.1.3 Common Modules

Table 6-3: Patient Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Patient's Name	(0010,0010)	PN	From worklist	Always
Patient's ID	(0010,0020)	LO	From worklist	Always, might be empty
Patient's Birth Date	(0010,0030)	DA	From worklist	Always
Patient's Sex	(0010,0040)	CS	From worklist	Always, might be empty

Table 6-4: General Study Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Study Date	(0008,0020)	DA	From worklist if available	Always, might be empty
Study Time	(0008,0030)	TM	From worklist if available	Always, might be empty
Accession Number	(0008,0050)	SH	From worklist	Always, might be empty
Referring Physician's Name	(0008,0090)	PN	From worklist	Not always present
Study Description	(0008,1030)	LO	From attribute (0032,1060) in the worklist or entered by the user	Always, might be empty
Procedure Code Sequence	(0008,1032)	SQ	From attribute (0032,1064) in the worklist or selected from a predefined list	Not always present
>Code Value	(0008,0100)	SH		Always
>Coding Scheme Designator	(0008,0102)	SH		Always
>Code Meaning	(0008,0104)	LO		Always
Name of Physician(s) Reading Study	(0008,1060)	PN	Selected from a predefined list	Not always present
Study Instance UID	(0020, 000D)	UI	Either from worklist entry or generated by the system	Always
Study ID	(0020, 0010)	SH	Generated by the system	Always, might be empty

Table 6-5: General Equipment Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Manufacturer	(0008,0070)	LO	"OCULUS Optikgeraete GmbH"	Always
Institution Name	(0008,0080)	LO	From the configuration file	Always, might be empty
Institution Address	(0008,0081)	ST	From the configuration file	Always, might be empty
Station Name	(0008,1010)	SH	From the configuration file	Always, might be empty
Institutional Department Name	(0008,1040)	LO	From the configuration file	Always, might be empty
Manufacturer's Model Name	(0008,1090)	LO	"Keratograph"	Always
Device Serial Number	(00018,1000)	LO	Serial number of the device	Always
Software Versions	(0018,1020)	LO	"0.0\1.17r61"	Always

Table 6-6: SC Equipment Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Modality	(0008,0060)	CS	"OT"	Always
Conversion Type	(0008,0064)	CS	"WSD"	Always
Secondary Capture Device ID	(0018,1010)	LO	Identifier, e.g. "70700"	Always
Secondary Capture Device Manufacturer	(0018,1016)	LO	"OCULUS Optikgeraete GmbH"	Always
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	LO	"Keratograph"	Always

Table 6-7: Private Data Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Private Creator	(0029,0010)	LO	"OCULUS Optikgeraete GmbH"	Always
Original Measuring Data	(0029,0010)	OB	Depends on measured data	Always
Original Measuring Data (Rwa Data)	(0029,0020)	OB	Depends on measured data	Not always

6.1.1.4   Encapsulated PDF Modules

Table 6-8: Encapsulated Document Series Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Modality	(0008,0060)	CS	See Table 6-6	
Series Instance UID	(0020,00E)	UI	Generated automatically	Always
Series Number	(0020,0011)	IS	Sequential number increased for each series within a study	Always
Performed Procedure Step Start Date	(0040,0244)	DA	Date of examination	Always
Performed Procedure Step Start Time	(0040,0245)	TM	Time of examination	Always
Performed Procedure Step ID	(0040,0253)	SH	From attribute (0040,0009) in the worklist or entered by the user	Not always present
Performed Procedure Step Description	(0040,0254)	LO	Entered by the user	Always, might be empty
Performed Protocol Code Sequence	(0040,0260)	SQ	Selected from a predefined list	Always
>Code Value	(0008,0100)	SH		Always
>Coding Scheme Designator	(0008,0102)	SH		Always
>Code Meaning	(0008,0104)	LO		Always
Comments on the Performed Procedure Step	(0040,0280)	ST	Entered by the user	Always, might be empty

Table 6-9: Encapsulated Document Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Instance Number	(0020,0013)	CS	Sequential number increased for each instance within a series	Always
Content Date	(0008,0023)	DA	Date of examination	Always
Content Time	(0008,0033)	TM	Time of examination	Always
Acquisition DateTime	(0008,002A)	DT		Always empty
Burned In Annotation	(0028,0301)	CS	"YES"	Always
Document Title	(0042,0010)	ST	Textual description of exported data	Always, might be empty
Concept Name Code Sequence	(0040,A043)	SQ		Always empty
MIME Type of Encapsulated Document	(0042,0012)	LO	"application/pdf"	Always
Encapsulated Document	(0042,0011)	OB	Depends on the content of the PDF document	Always

Table 6-10: SOP Common Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Specific Character Set	(0008,0005)	CS	"ISO_IR 100"	Always
Instance Creation Date	(0008,0012)	DA	Current date	Always
Instance Creation Time	(0008,0013)	TM	Current time	Always
SOP Class UID	(0008,0016)	UI	"1.2.840.10008.5.1.4.1.1. 104.1"	Always
SOP Instance UID	(0008,0018)	UI	Generated automatically	Always

6.1.1.5   Secondary Capture Image Modules

Table 6-11: General Series Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Series Date	(0008,0021)	DA	Date the series started	Always
Series Time	(0008,0031)	TM	Time the series started	Always
Modality	(0008,0060)	CS	See Table 6-6	
Performing Physicians' Name	(0008,1050)	PN	Selected from a predefined list	Always, might be empty
Operators' Name	(0008,1070)	PN	Selected from a predefined list	Always, might be empty
Body Part Examined	(0018,0015)	CS	"HEAD"	Always
Protocol Name	(0018,1030)	LO	Generated automatically from performed examination type	Always, might be empty
Patient Position	(0018,5100)	CS		Never
Series Instance UID	(0020,000E)	UI	Generated automatically	Always
Series Number	(0020,0011)	IS	Sequential number increased for each examination performed	Always
Laterality	(0020,0060)	CS	"L" or "R"	Always
Performed Procedure Step Start Date	(0040,0244)	DA	Date of examination	Always
Performed Procedure Step Start Time	(0040,0245)	TM	Time of examination	Always
Performed Procedure Step ID	(0040,0253)	SH	From attribute (0040,0009) in the worklist or selected from a predefined list	Always, might be empty
Performed Procedure Step Description	(0040,0254)	LO	Entered by the user	Always, might be empty
Performed Protocol Code Sequence	(0040,0260)	SQ	Selected from a predefined list	Always, might be empty
>Code Value	(0008,0100)	SH		Always
>Coding Scheme Designator	(0008,0102)	SH		Always
>Code Meaning	(0008,0104)	LO		Always
Comments on the Performed Procedure Step	(0040,0280)	ST	Entered by the user	Always, might be empty

Table 6-12: General Image Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Image Type	(0008,0008)	CS		Never
Content Date	(0008,0023)	DA	Date of examination	Always
Content Time	(0008,0033)	TM	Time of examination	Always
Instance Number	(0020,0013)	IS	Sequential number increased for each instance within a series	Always
Patient Orientation	(0020,0020)	CS		Never

Table 6-13: General Pixel Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Samples Per Pixel	(0028,0002)	US	3	Always
Photometric Interpretation	(0028,0004)	CS	"RGB"	Always
Planar Configuration	(0028,0006)	US	0	Always
Rows	(0028,0010)	US	Depends on the height of the image	Always
Columns	(0028,0011)	US	Depends on the width of the image	Always
Pixel Aspect Ratio	(0028,0034)	IS		Never
Bits Allocated	(0028,0100)	US	8	Always
Bits Stored	(0028,0101)	US	8	Always
High Bit	(0028,0102)	US	7	Always
Pixel Representation	(0028,0103)	US	0	Always
Pixel Data	(7FE0,0010)	OB	Depends on the content of the image	Always

Table 6-14: SOP Common Module of Created SOP Instances

Attribute Name	Tag	VR	Value	Presence of Value
Specific Character Set	(0008,0005)	CS	"ISO_IR 100"	Always
SOP Class UID	(0008,0016)	UI	"1.2.840.10008.5.1.4.1.1.7"	Always
SOP Instance UID	(0008,0018)	UI	Generated automatically	Always

6.1.2 Usage of Attributes from Received IODs

OCULUS Keratograph does not receive any IODs.

6.1.3 Attribute Mapping

OCULUS Keratograph does not use any attribute mapping.

6.1.4 Coerced / Modified Fields

OCULUS Keratograph does not modify any fields.

6.2 Data Dictionary of Private Attributes

The private attributes added to created SOP instances are listed in Table 6-15. OCULUS Keratograph reserves a block of private attributes in the range of (0029,1000) to (0029,10FF). Further details on the usage of these private attributes are described in section 6.1.

Table 6-15: Data Dictionary of Private Attributes in Created SOP Instances

Tag	Attribute Name	VR	VM	Attribute Description
(0029,0010)	Private Creator	LO	1	Identification of the creator of the group of private data elements
(0029,1010)	Original Measuring Data	OB	1	Measured topographic data
(0029,1020)	Original Measuring Data (Raw Data)	OB	1	Raw images and measured data

6.3 Coded Terminology and Templates

OCULUS Keratograph does not use or support any coded terminology or templates.

6.4 Grayscale Image Consistency

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

6.5 Standard Extended / Specialized / Private SOP Classes

OCULUS Keratograph uses a standard extended SOP class for the Encapsulated PDF and Secondary Capture Image IOD by adding a private data module. See section 6.1 for details.

The system does not support any specialized or private SOP classes.

6.6   Private Transfer Syntaxes

OCULUS Keratograph does not use or support any private transfer syntaxes.

6.7   Address of the manufacturer and service department

Our service department or authorised representatives will furnish you with additional information.

Address of the manufacturer and service department:

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