DICOM

Conformance Statement

 Xperius 1.5.x

 000621000000042 Rev A

 2018-07-06







© Koninklijke Philips Electronics N.V. 2018

All rights are reserved.

## Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| Document Version | Date of Issue | Authors | Description |
| A | 6 July 2018 | ML | Initial Release |

# CONFORMANCE STATEMENT OVERVIEW

The Philips Xperius Ultrasound systems implement the necessary DICOM[[1]](#footnote-1)® services to download worklists from an information system, save acquired US Images to a network storage device and inform the information system about the work actually done.

Table 1 provides an overview of the supported network services.

Table 1

NETWORK SERVICES

|  |  |  |
| --- | --- | --- |
| Networking SOP Classes | **User of** **Service (SCU)** | **Provider of Service (SCP)** |
| Transfer |  |  |
| Ultrasound Image Storage | Yes | No |
| Ultrasound Multiframe Image Storage | Yes | No |
| Workflow Management |  |  |
| Modality Worklist | Yes | No |

Table 2 below specifies the Media Storage Application Profiles supported.

Table 2

Media Services

|  |  |  |
| --- | --- | --- |
| Media Storage Application Profile | Write Files (FSC or FSU) | Read Files (FSR) |
| **USB Devices** |  |  |
| STD-GEN-USB-JPEGfor Ultrasound images | Yes / Yes | No |

# TABLE OF CONTENTS

[0.1 Revision History 2](#_Toc475607394)

[1 CONFORMANCE STATEMENT OVERVIEW 3](#_Toc475607395)

[2 TABLE OF CONTENTS 4](#_Toc475607396)

[3 INTRODUCTION 6](#_Toc475607397)

[3.1 AUDIENCE 6](#_Toc475607398)

[3.2 REMARKS 6](#_Toc475607399)

[3.3 Important Note to the Reader 6](#_Toc475607400)

[3.4 DEFINITIONS, TERMS AND ABBREVIATIONS 7](#_Toc475607401)

[3.5 REFERENCES 7](#_Toc475607402)

[4 NETWORKING 8](#_Toc475607403)

[4.1 IMPLEMENTATION MODEL 8](#_Toc475607404)

[4.1.1 Application Data Flow 8](#_Toc475607405)

[4.1.2 Functional Definition of AEs 8](#_Toc475607406)

[4.1.2.1 Functional Definition of Storage Application Entity 8](#_Toc475607407)

[4.1.2.2 Functional Definition of Workflow Application Entity 8](#_Toc475607408)

[4.1.3 Sequencing of Real-World Activities 9](#_Toc475607409)

[4.2 AE SPECIFICATIONS 10](#_Toc475607410)

[4.2.1 Storage Application Entity Specification 10](#_Toc475607411)

[4.2.1.1 SOP Classes 10](#_Toc475607412)

[4.2.1.2 Association Establishment Policy 10](#_Toc475607413)

[4.2.1.2.1 General 10](#_Toc475607414)

[4.2.1.2.2 Number of Associations 10](#_Toc475607415)

[4.2.1.2.3 Asynchronous Nature 10](#_Toc475607416)

[4.2.1.2.4 Implementation Identifying Information 10](#_Toc475607417)

[4.2.1.3 Association Initiation Policy 11](#_Toc475607418)

[4.2.1.3.1 Activity – Store Images and Loops 11](#_Toc475607419)

[4.2.1.3.1.1 Description and Sequencing of Activities 11](#_Toc475607420)

[4.2.1.3.1.2 Proposed Presentation Contexts 12](#_Toc475607421)

[4.2.1.3.1.3 SOP Specific Conformance for Image SOP Classes 12](#_Toc475607422)

[4.2.2 Workflow Application Entity Specification 14](#_Toc475607423)

[4.2.2.1 SOP Classes 14](#_Toc475607424)

[4.2.2.2 Association Establishment Policy 14](#_Toc475607425)

[4.2.2.2.1 General 14](#_Toc475607426)

[4.2.2.2.2 Number of Associations 14](#_Toc475607427)

[4.2.2.2.3 Asynchronous Nature 14](#_Toc475607428)

[4.2.2.2.4 Implementation Identifying Information 14](#_Toc475607429)

[4.2.2.3 Association Initiation Policy 15](#_Toc475607430)

[4.2.2.3.1 Activity – Worklist Update 15](#_Toc475607431)

[4.2.2.3.1.1 Description and Sequencing of Activities 15](#_Toc475607432)

[4.2.2.3.1.2 Proposed Presentation Contexts 15](#_Toc475607433)

[4.2.2.3.1.3 SOP Specific Conformance for Modality Worklist 16](#_Toc475607434)

[4.2.3 Verification Application Entity specification 18](#_Toc475607435)

[4.2.3.1 SOP Class 18](#_Toc475607436)

[4.2.3.2 Association Establishment Policy 18](#_Toc475607437)

[4.2.3.2.1 General 18](#_Toc475607438)

[4.2.3.2.2 Number of Associations 18](#_Toc475607439)

[4.2.3.2.3 Asynchronous Nature 18](#_Toc475607440)

[4.2.3.2.4 Implementation Identifying Information 18](#_Toc475607441)

[4.2.3.3 Association Initiation Policy 19](#_Toc475607442)

[4.2.3.3.1 Activity – Verify as SCU 19](#_Toc475607443)

[4.2.3.3.1.1 Description and Sequencing of Activities 19](#_Toc475607444)

[4.2.3.3.1.2 Proposed Presentation Contexts 20](#_Toc475607445)

[4.2.3.3.1.3 SOP Specific Conformance for Verification 20](#_Toc475607446)

[4.2.3.4 Association Acceptance Policy 20](#_Toc475607447)

[4.2.3.4.1 Verification 20](#_Toc475607448)

[4.3 PHYSICAL NETWORK INTERFACES 21](#_Toc475607449)

[4.3.1 Supported Communication Stacks 21](#_Toc475607450)

[4.3.1.1 TCP/IP Stack 21](#_Toc475607451)

[4.3.2 Physical Network Interface 21](#_Toc475607452)

[4.3.3 Additional Protocols 21](#_Toc475607453)

[4.3.4 IPv4 and IPv6 Support 21](#_Toc475607454)

[4.4 CONFIGURATION 21](#_Toc475607455)

[4.4.1 AE Title/Presentation Address Mapping 21](#_Toc475607456)

[4.4.1.1 Secure DICOM Configuration Option 22](#_Toc475607457)

[4.4.1.2 Local AE Title 22](#_Toc475607458)

[4.4.1.3 Remote AE Title/Presentation Address Mapping 22](#_Toc475607459)

[4.4.2 Workflow 22](#_Toc475607460)

[5 MEDIA STORAGE 23](#_Toc475607461)

[5.1 IMPLEMENTATION MODEL 23](#_Toc475607462)

[5.1.1 Application Data Flow 23](#_Toc475607463)

[5.1.2 Functional Definition of AEs 23](#_Toc475607464)

[5.1.2.1 Functional Definition of Media Application Entity 23](#_Toc475607465)

[5.1.3 Sequencing of Real-World Activities 23](#_Toc475607466)

[5.1.4 File Meta Information Options 23](#_Toc475607467)

[5.2 AE SPECIFICATIONS 24](#_Toc475607468)

[5.2.1 Media Application Entity Specification 24](#_Toc475607469)

[5.2.1.1 File Meta Information for the Application Entity 24](#_Toc475607470)

[5.2.1.2 Real-World Activities 24](#_Toc475607471)

[5.2.1.2.1 Activity – Send to Media – “Export” 24](#_Toc475607472)

[5.2.1.2.2 Activity – Update to Media – Export” 24](#_Toc475607473)

[5.2.1.2.2.1 Media Storage Application Profiles 24](#_Toc475607474)

[5.2.1.2.2.2 Options 24](#_Toc475607475)

[6 SUPPORT OF CHARACTER SETS 27](#_Toc475607476)

[7 SECURITY 28](#_Toc475607477)

[7.1 General Security 28](#_Toc475607478)

[7.2 Supported DICOM Security Profiles 28](#_Toc475607479)

[7.2.1 TLS Secure Transport Connection Profiles 28](#_Toc475607480)

[8 ANNEXES 29](#_Toc475607481)

[8.1 CREATED IOD INSTANCES 29](#_Toc475607482)

[8.1.1 US or US Multiframe Image IOD 29](#_Toc475607483)

[8.1.2 Common Modules 30](#_Toc475607484)

[8.1.3 US or Multiframe Image Modules 32](#_Toc475607485)

[8.2 USED FIELDS IN RECEIVED IOD BY APPLICATION 36](#_Toc475607486)

[8.3 ATTRIBUTE MAPPING 36](#_Toc475607487)

[8.4 CONTROLLED TERMINOLOGY 37](#_Toc475607488)

[8.5 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS 37](#_Toc475607489)

# INTRODUCTION

## AUDIENCE

This document is intended for hospital staff, health care system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

## REMARKS

DICOM, by itself, does not guarantee interoperability. However, the Conformance Statement facilitates a first-level validation for interoperability between different applications supporting the same DICOM functionality.

This Conformance Statement is not intended to replace validation with other DICOM equipment to ensure proper exchange of information intended.

The scope of this Conformance Statement is to facilitate communication between the Philips Healthcare Xperius ultrasound systems and other vendors’ Medical equipment. The Conformance Statement should be read and understood in conjunction with the DICOM Standard [DICOM]. However, by itself it is not guaranteed to ensure the desired interoperability and successful interconnectivity.

The user should be aware of the following important issues:

— The comparison of different conformance statements is the first step towards assessing interconnectivity between Philips Healthcare and non - Philips Healthcare equipment.

— Test procedures should be defined to validate the desired level of connectivity.

— The DICOM standard will evolve to meet the users’ future requirements. Philips Healthcare is actively involved in developing the standard further and therefore reserves the right to make changes to its products or to discontinue its delivery.

## Important Note to the Reader

**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 an IT 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 analyze 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).

## DEFINITIONS, TERMS AND ABBREVIATIONS

Definitions, terms and abbreviations used in this document are defined within the different parts of the DICOM standard.

Abbreviations and terms are as follows:

AE DICOM Application Entity

AET Application Entity Title

DICOM Digital Imaging and Communications in Medicine

FSC File-Set Creator

FSU File-Set Updater

FSR File-Set Reader

GSDF Grayscale Standard Display Function

IOD (DICOM) Information Object Definition

ISO International Standard Organization

MWL Modality Worklist

R Required Key Attribute for Modality Worklist Query Matching

O Optional Key Attribute for Modality Worklist Query Matching

PDU DICOM Protocol Data Unit

PDE Patient Data Entry

SCP DICOM Service Class Provider (DICOM server)

SCU DICOM Service Class User (DICOM client)

SOP DICOM Service-Object Pair

U Unique Key Attribute for Modality Worklist Query Matching, or Optional Attribute

US Ultrasound

## REFERENCES

DICOM] Digital Imaging and Communications in Medicine, Parts 1 - 20 (NEMA PS 3.1- PS 3.20),
National Electrical Manufacturers Association (NEMA)
Publication Sales 1300 N. 17th Street, Suite 1752 Rosslyn, Virginia. 22209, United States of America
Internet: http://medical.nema.org/

Note that at any point in time the official standard consists of the most recent yearly edition of the base standard (currently 2017) plus all the supplements and correction items that have been approved as Final Text.

##

# NETWORKING

## IMPLEMENTATION MODEL

### Application Data Flow



Figure 1
Application Data Flow Diagram

— The **Storage Application Entity** sends **Images** to a single remote AE by user selection of the exam from “Review”.

* The **Workflow Application Entity** receives Worklist information remote AEs. It is associated with the local real-world activities “Refresh.” When the “Refresh” is performed, the Workflow Application Entity queries a remote AE for worklist items that provides the set of worklist items matching the query request. The system will only perform updates based on the setting of the update interval. No manual update is available.

### Functional Definition of AEs

#### Functional Definition of Storage Application Entity

A Network Store queue with associated network destination will activate the Storage AE. An association request is sent to the destination AE and upon successful negotiation of a Presentation Context the image transfer is started. If the association cannot be opened, the related queue’s Status is set to “Stopped” as displayed in the Job Manager, Settings> System> Diagnostics> Job Queue> Jobs... The user may select “Retry Job” to attempt re-send. After the automatic retries have failed, the job is set to “ERROR.” The user may select “Delete Job” and re-send manually. Deleting a job does not remove the data, as it is still present on the system. Only the request to transfer the data is removed. Once any communication issues have been resolved, “Retry Job” may be selected or if the jobs were deleted, they may be queued again from the Review directory.

#### Functional Definition of Workflow Application Entity

“Refresh” attempts to download a Modality Worklist from a Modality Worklist server with studies matching the search criteria by sending a C-Find Request. Query parameters are stored in the “Set Modality Worklist Query” Dialog.

Settings that may be customized are:

* Start Date (Today, ±24 hours of today, “yesterday today and tomorrow” and past 30 days plus next 7 days)
* AE Title (This system, Any)
* Modality (Ultrasound or All Modalities)

When the Workflow AE establishes an association to a remote AE, a MWL C-Find-Rq message is sent to the MWL server. The server will transfer all matching worklist items via the open association. The results of a successful Worklist Update will overwrite the data in the Worklist display.

There is no queue management for Worklist.

### Sequencing of Real-World Activities



Figure 2
Sequencing Constraints

## AE SPECIFICATIONS

### Storage Application Entity Specification

#### SOP Classes

Table 1
SOP Classes for AE Storage

|  |  |  |  |
| --- | --- | --- | --- |
| SOP Class Name | SOP Class UID | SCU | SCP |
| US Image Storage | 1.2.840.10008.5.1.4.1.1.6.1 | Yes | No |
| US Multiframe Image Storage | 1.2.840.10008.5.1.4.1.1.3.1 | Yes | No |

#### Association Establishment Policy

##### General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 2
DICOM Application Context for AE Storage

|  |  |
| --- | --- |
| Application Context Name | 1.2.840.10008.3.1.1.1 |

The PDU size is configurable with a minimum size of 100 and a maximum size of 16,000. The default PDU size is 16,000.

##### Number of Associations

Xperius initiates one Association at a time for each destination to which a transfer request is being processed in the active job queue list.

Table 3
Number of Associations Initiated for AE Storage

|  |  |
| --- | --- |
| Maximum number of simultaneous Associations | 1 |

#####

##### Asynchronous Nature

Xperius does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 4
Asynchronous Nature as a SCU for AE Storage

|  |  |
| --- | --- |
| Maximum number of outstanding asynchronous transactions | 1  |

##### Implementation Identifying Information

The implementation information for this Application Entity is:

Table 5
DICOM Implementation Class and Version for AE Storage

|  |  |
| --- | --- |
| Implementation Class UID | 1.3.46.670589.14.8200.150 |
| Implementation Version Name | XPERIUS\_1.5 |

#### Association Initiation Policy

##### Activity – Store Images and Loops

###### Description and Sequencing of Activities

Selected studies may be sent from the Review directory. This is associated with the configuration setting, “Manual”. The system supports automatic export when pressing “End Exam” using the “Batch mode” transfer selection or sending images as they are acquired using “Send as you go” selection in Advanced settings for the selected “Primary Storage SCP”

If the C-STORE response from the remote application contains a status other than Success or Warning, the association is retried until switched to a failed state.

The sequencing of messaging for each of the storage configurations is shown in the following drawings.



Figure 3
Sequencing of Activity – Send FROM REVIEW



Figure 4
Sequencing of Activity – Send AT END OF EXAM



Figure 5
Sequencing of Activity – Send AS YOU GO

######  Proposed Presentation Contexts

Xperius is capable of proposing the Presentation Contexts shown in the following table:

Table 6
Proposed Presentation Contexts for Activity Send Images

|  |
| --- |
| Presentation Context Table |
| Abstract Syntax | Transfer Syntax | Role | Ext.Neg. |
| Name | UID | Name List | UID List |
| US Image Storage\* | 1.2.840.10008.5.1.4.1.1.6.1 | Implicit Little EndianJPEG Lossy Baseline | 1.2.840.10008.1.21.2.840.10008.1.2.4.50 | SCU | None |
| US Multiframe Image Storage\* | 1.2.840.10008.5.1.4.1.1.3.1 | Implicit Little Endian JPEG Lossy Baseline | 1.2.840.10008.1.21.2.840.10008.1.2.4.50 | SCU | None |

\*The following applies to both US Image and US Multiframe Images
JPEG Lossy used if image Photometric Interpretation is
 YBR\_FULL\_422
Implicit Little Endian (ILE) transfer Syntax is used when:
 Palette Color,
 RGB,
 MONOCHROME2

###### SOP Specific Conformance for Image SOP Classes

All SOP Classes supported by the Storage AE exhibit the same behavior, except where stated, and are described together in this section.

Table 7 describes C-Store response behavior.

The following Default Settings and Ranges may be used where applicable in Table 7:

|  |  |
| --- | --- |
| **Setting** | **Default** |
| Connect Timeout  | 30 sec |
| Read Timeout  | 300 sec |
| Retry Interval  | 120 sec |
| Maximum Retries  | 20 |

Establishing the Association with Default settings

Table 7
Storage C-STORE Response Status Handling Behavior

| **Condition**(After C-Store) | **Status Codes**(C-Store-RSP) | **Response** |
| --- | --- | --- |
| Could not establish the association within 30-second time window (Connect Timeout) due to NO RESPONSE from the Storage Server | Not Applicable | The association attempt is aborted, and after 2-minutes a new association is attempted. Xperius will make twenty attempts to open an association with the configured Storage SCP before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The 2-minute timeout and the number of retries are configurable by the user from the DICOM Setup screens. The 2-minute timeout is mapped to the ‘Retry Interval’ input control on the DICOM Setup screen and the number of retries is mapped to ‘Maximum Retries’ on the DICOM Setup screen. |
| Refused | A7xx | If the Storage SCP server refuses the association, then the association attempt is aborted. Xperius will wait 2-minutes and then reattempt the association. Xperius will make twenty attempts to establish the association before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. The failure is logged to the DICOM log file as an error.As an example, the association would be refused if the storage server employs a high security mechanism whereby it only accepts association requests from DICOM Servers that it knows about and the Xperius’s AE Title was not in the PACS database.See the timeout and retry settings above. |

During Image Transfer

Table 8

|  |  |  |
| --- | --- | --- |
| Service Status | Error Code | Behavior |
| After association has been accepted, there is no response to a request within 5-minute time window (Read Timeout). | Not Applicable | If the association is lost during active image transfer to the Storage SCP server, Xperius will initiate a new association after 2 minutes, and attempt to store all the images. If during transfer, the association is again lost, Xperius will wait another minutes and try again. Xperius will make twenty attempts to send all the images before aborting the storage request and placing the job in an error state. The user can then manually restart the job at some later date. See the timeout and retry settings above. |
| Error | A9xx,Cxxx,0122,Other | Xperius will treat all errors as failure of Storage request (also called as Job). A failed job is automatically retried after 2 minutes. If the job fails even after twenty attempts, Xperius will abort this request and place the job in an Error state. The user can then manually restart the job at some later date.  |
| Warning | D000,B000,B006,B007 | If the Storage SCP issues a warning on a particular image (perhaps it had to use coercion), Xperius logs the warning to the DICOM log file as an informational event and continues on as if the image was successfully stored to the PACS (see row below). |
| Success | 0000 | When an image is successfully stored to the Storage SCP (PACS), Xperius will keep a record of the successful storage. If all the images in the job are successfully stored, Xperius will notify the user (through an icon on the list of studies), and the job will be removed from the job manager.  |

The behavior of Storage AE during communication failure is summarized in Table 9.

Table 9
Storage Communication Failure Behavior

|  |  |
| --- | --- |
| Exception | Behavior |
| Timeout | Same as Service Status timeouts in Table 8 above. |
| Association aborted by the SCP or network layers | Same as Service Status in Table 8 above. |

The contents of US Image and US Multiframe Storage SOP Instances conform to the DICOM IOD definitions described in Section 8.1.

### Workflow Application Entity Specification

#### SOP Classes

Xperius provides Standard Conformance to the following SOP Classes:

Table 10
SOP Classes for AE Workflow

|  |  |  |  |
| --- | --- | --- | --- |
| SOP Class Name | SOP Class UID | SCU | SCP |
| MWL Information Model – FIND | 1.2.840.10008.5.1.4.31 | Yes | No |

#### Association Establishment Policy

##### General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 11
DICOM Application Context for AE Workflow

|  |  |
| --- | --- |
| Application Context Name | 1.2.840.10008.3.1.1.1 |

##### Number of Associations

Xperius initiates one Association at a time for a Worklist request.

Table 12
Number of Associations Initiated for AE Workflow

|  |  |
| --- | --- |
| Maximum number of simultaneous Associations | 1 |

##### Asynchronous Nature

Xperius does not support asynchronous communication.

Table 13
Asynchronous Nature as a SCU for AE Workflow

|  |  |
| --- | --- |
| Maximum number of outstanding asynchronous transactions | 1 |

##### Implementation Identifying Information

The implementation information for this Application Entity is:

Table 14
DICOM Implementation Class and Version for AE Workflow

|  |  |
| --- | --- |
| Implementation Class UID | 1.3.46.670589.14.8200.150 |
| Implementation Version Name | XPERIUS\_1.5 |

#### Association Initiation Policy

##### Activity – Worklist Update

###### Description and Sequencing of Activities

Worklist queries for Modality (US) or All Modalities only at specified interval. No manual refresh.

A possible sequence of interactions between the Workflow AE and a Departmental Scheduler (e.g. a device such as a RIS or HIS which supports the MWL SOP Class as an SCP) is illustrated in Figure 4.



Figure 6
Sequencing of Activity – Worklist Update

###### Proposed Presentation Contexts

Xperius will propose Presentation Contexts as shown in the following table:

Table 15
Proposed Presentation Contexts for Activity Worklist Update

|  |
| --- |
| 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 | Explicit VR Little Endian\*Implicit VR Little Endian | 1.2.840.10008.1.2.11.2.840.10008.1.2 | SCU | None |

\*Note: If the worklist server accepts Explicit VR Little Endian and Implicit VR Little Endian then Xperius will use Explicit VR Little Endian Transfer Syntax.

######  SOP Specific Conformance for Modality Worklist

Table 16 summarizes the behavior of Xperius when encountering status codes in a MWL C-FIND response.

A message “query failed” will appear on the user interface if Xperius receives any other SCP response status than “Success” or “Pending.”

Table 16
Modality Worklist C-FIND Response Status Handling Behavior

|  |  |  |  |
| --- | --- | --- | --- |
| Service Status | Further Meaning | Error Code | Behavior |
| Success | Matching is complete | 0000 | The system replaced the worklist from the response.  |
| Refused | Out of Resources | A700 | The Association is aborted using A-ABORT. The worklist is not replaced.  |
| Failed | Identifier does not match SOP Class | A900 | Same as “Refused” above. |
| Failed | Unable to Process | C000 – CFFF | Same as “Refused” above. |
| Cancel | Matching terminated due to Cancel request | FE00 | The user is notified that a partial list was retrieved. The retrieved items can be displayed by user request. |
| Pending | Matches are continuing | FF00 | Continue. |
| Pending | Matches are continuing – Warning that one or more Optional Keys were not supported | FF01 | Continue. |
| \* | \* | Any other status code. | Same as “Refused” above. |

 Table 17 summarizes the behavior of Xperius during communication failure.

Table 17
Modality Worklist Communication Failure Behavior

|  |  |
| --- | --- |
| Exception | Behavior |
| Timeout | Same as Service Status “Refused” in the table above. |
| Association aborted by the SCP or network layers | Same as Service Status “Refused” in the table above. |

Table 18 describes the Xperius Worklist Matching Keys and requested attributes. Unexpected attributes returned in a C-FIND response are ignored.

Non-matching responses returned by the SCP due to unsupported optional matching keys are ignored.

Table 18
Worklist Matching Keys

| Module Name Attribute Name | Tag | VR | B | R | D | IOD |
| --- | --- | --- | --- | --- | --- | --- |
| **Scheduled Procedure Step** Scheduled Procedure Step Sequence > Scheduled Station AE Title > Scheduled Procedure Step Start Date> Scheduled Procedure Step Start Time > Modality >Scheduled Performing Physician’s Name1 | (0040,0100)(0040,0001)(0040,0002)(0040,0003)(0008,0060)(0040,0006) | SQAEDA TMCSPN | S\*SS | xxxxx | xxx | xx |
| **Requested Procedure** Requested Procedure Description2 Study Instance UID | (0032,1060)(0020,000D) | LOUI |  | xx | x | x |
| **Imaging Service Request** Accession Number | (0008,0050) | SH |  | x | x | x |
| **Patient Identification** Patient’s Name Patient ID | (0010,0010)(0010,0020) | PNLO |  | xx | xx | xx |
| **Patient Demographic** Patient’s Birth Date Patient’s Sex Patient Size Patient’s Weight | (0010,0030)(0010,0040)(0010,1020)(0010,1030) | DACSDSDS |  | xxxx | xx | xxx |

The above table should be read as follows:

Module Name: The name of the associated module for supported worklist attributes.

Attribute Name: Attributes supported to build an Xperius Worklist Request Identifier.

Tag: DICOM tag for this attribute.

VR: DICOM VR for this attribute.

B: Matching keys for Broad Worklist Update. An "S" indicates that Xperius supplies an attribute value for Single Value Matching; S\* if configured in MWL SCP Advanced Settings

R: Return keys. An "x" indicates that Xperius supplies this attribute as a Return Key with zero length for Universal Matching. NOTE: This table only includes the return keys present in the Request that are used in either the display or IOD.

D: Displayed keys. An “x” indicates that this worklist attribute is displayed to the user in the Patient Data Entry screen or Worklist Directory.

IOD: An "x" indicates that this Worklist attribute’s data is included into applicable Image Object Instances created during performance of the related Procedure Step.

Notes:

1 Scheduled Performing Physician’s Name sets the “Physician” field in Patient Data Entry Screen and is mapped into Performing Physician Name and Operator’s Name in Image IODs

2 Requested Procedure Description is only displayed in the Patient Worklist page when the procedure step is selected.

### Verification Application Entity specification

#### SOP Class

Xperius provides Standard Conformance to the following SOP Class:

Table 19
SOP Classes for AE verification

|  |  |  |  |
| --- | --- | --- | --- |
| SOP Class Name | SOP Class UID | SCU | SCP |
| Verification | 1.2.840.10008.1.1 | Yes | No |

#### Association Establishment Policy

##### General

The DICOM standard application context name for DICOM 3.0 is always proposed:

Table 20
DICOM Application Context for AE verification

|  |  |
| --- | --- |
| Application Context Name | 1.2.840.10008.3.1.1.1 |

##### Number of Associations

Xperius initiates one Association at a time for a Verification request.

Table 21
Number of Associations Initiated for AE Verification

|  |  |
| --- | --- |
| Maximum number of simultaneous Associations | 1 |

##### Asynchronous Nature

Xperius does not support asynchronous communication (multiple outstanding transactions over a single Association).

Table 22
Asynchronous Nature as a SCU for AE verification

|  |  |
| --- | --- |
| Maximum number of outstanding asynchronous transactions | 1 |

##### Implementation Identifying Information

The implementation information for this Application Entity is:

Table 23
DICOM Implementation Class and Version for AE verification

|  |  |
| --- | --- |
| Implementation Class UID | 1.3.46.670589.14.8200.150 |
| Implementation Version Name | XPERIUS\_1.5 |

#### Association Initiation Policy

##### Activity – Verify as SCU

###### Description and Sequencing of Activities

 **SCU:** The user can verify the existence of a DICOM server on the hospitals network, through the “Ping” button on the DICOM Node’s Setup Dialog. When the user presses this button, Xperius will initiate the association.

Only one association is established for each verification attempt.



Figure 7
Sequencing of Activity – Issue Verify

###### Proposed Presentation Contexts

Table 24
Proposed Presentation Contexts for Activity Verify As Scu

| Presentation Context Table |
| --- |
| Abstract Syntax | Transfer Syntax | Role | Ext.Neg. |
| Name | UID | Name List | UID List |
| Verification | 1.2.840.10008.1.1 | Implicit VR Little EndianJPEG Lossy Baseline\* | 1.2.840.10008.1.21.2.840.10008.1.2.4.50 | SCU  | None |

\*Note: Only present during verification command. Implicit Little Endian is used for all image transfers.

###### SOP Specific Conformance for Verification

No SOP Specific behavior

#### Association Acceptance Policy

##### Verification

Table 25 summarizes the behavior of Xperius when receiving status codes in a C-ECHO response.

A message will appear on the user interface if Xperius receives any other SCP response status than “Success.”

Table 25
verification c-echo Response Status Handling Behavior

| Service Status | Further Meaning | Error Code | Behavior |
| --- | --- | --- | --- |
| Success |  | 0000 | Device Status is set to: Verified |
| Refused | Out of Resources | A700 | Device Status is set to: Not Verified |
| Failed | Unable to Process | C000 – CFFF | Same as “Refused” above. |
| \* | \* | Any other status code. | Same as “Refused” above. |

## PHYSICAL NETWORK INTERFACES

### Supported Communication Stacks

#### TCP/IP Stack

The system provides only DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 of the standard.

The TCP/IP Stack, as supported by the underlying Operating System, is the only protocol stack supported.

### Physical Network Interface

The Xperius 1.5.x system supports one network interface at a time. The following physical network interfaces are available:.

Table 26

Supported Physical Network Interface

|  |
| --- |
| 1. 802.11 a/b/g/n/ac Wireless
 |
| 1. Ethernet 10/100/1000 BaseT, RJ-45, AutoDetect Speed, Full or Half Duplex
 |

### Additional Protocols

Not Applicable

### IPv4 and IPv6 Support

IPv4 and IPv6 are supported.

## CONFIGURATION

Any implementation's DICOM conformance may be dependent upon configuration, which takes place at the time of installation. Issues concerning configuration are addressed in this section.

### AE Title/Presentation Address Mapping

An important installation issue is the translation from AE title to presentation address. How this is to be performed is described here.

The DICOM setup screen allows the user to configure a significant number of options including (but not limited to):

* For the Xperius system, its AE Title, IP Address and Port number, and wired or wireless connection.
* For DICOM servers, their AE Title, Port number, IP address.
* For Storage SCP’s and for media storage; the image format.

Advanced settings (including Photometric Interpretation settings: MONOCHROME2, RGB, Palette color and YBR\_FULL\_422).

* For a MWL server, the query parameters: Scheduled Procedure Start Date range, Modality, AE Title and update interval.

The Devices Configuration section allows configuration of the following device types:

|  |  |
| --- | --- |
| **Device Type** | **Supported SOPs** |
| Primary Storage SCP | Ultrasound StoreUltrasound Multiframe Store |
| MWL SCP | Modality Worklist |

To configure a server that supports image store, a “Server” entry must be configured under “Settings>DICOM…>Change Settings >Servers and Roles>Servers”. Enter a Name (an ‘alias’ used in the system UI only), the appropriate AE Title, IP Address, Port number and timeout values. “Ping” sends an ICMP ping message to the address and a DICOM Verification Association message to the IP, Port and AE Title. A success message is displayed if all is configured correctly at this level. If not, an error message dialog is displayed indicating possible reasons and suggested corrective actions. Once successful, Hit “Done” to continue to Role definition.

Once the server data is defined, then its role and options are configured. For each role, as in Primary Storage SCP or MWL, select the server’s alias name from the list. If “Advanced” options are available, select the “Advanced” button to access them.

When Role configuration is completed and “Done” is selected under “Roles”, then another set of Verification messages are sent to each server confirming network connectivity and DICOM role support. A dialog box updates as the tasks are in progress. No error messages indicates successful configuration.

#### Secure DICOM Configuration Option

DICOM Setup supports the ability to make secure connections between the ultrasound system and DICOM servers. The “DICOM Setup” page includes the “This System” tab that includes a “Secure DICOM” button. Select that button to open the “Secure DICOM Configuration” dialog and select the “Modify” button. Select the “Use Transport Layer Security (Use TLS) checkbox and optionally the “Use TLS Encryption” box.

With a USB device connected to the system containing the certificates, select “Manage Certificates” to enter certificates. Detailed instructions are available in Help on the system.

After entering the certificates into the system, make the selection for “\* This System’s Certificate:”

Similarly, with the certificates imported into the system, when configuring remote servers to connect with under the “Systems and Roles” tab, the correct certificate may be selected in the “Servers” side’s “Secure DICOM” button.

Note: If the system is set for Secure DICOM, it will only communicate with secure devices, and the system’s default listening port will change from 104 to 2762.

#### Local AE Title

All local AEs use the same AE Title and TCP/IP Port configured via the Settings>DICOM…>Change Settings >This System screen. The system listens on the configured Port only for Verification requests. The system supports Static Addressing or DHCP to receive its IP Address, Subnet Mask and Default Gateway address.

#### Remote AE Title/Presentation Address Mapping

The AE Titles, IP Addresses and Port numbers of remote applications are manually configured using the Settings>DICOM…>Change Settings >Servers and Roles. The remote system’s IP Address may be entered manually if known or the Host Name of the remote device may be entered and resolved by the DNS if the network includes this service.

### Workflow

DICOM Setup is used to set the AE Title, Port number and IP ­Address the remote MWL SCP. Multiple MWL SCPs may be defined, but only a single remote MWL SCP can be selected at a time.

The default MWL query uses Modality = “US”. This may be changed in the “Set Modality Worklist Query Customizable Queries” definition page. Alternately, “All Modalities” may be selected.

“AE Title” may be selected as the system’s or a custom query value may be defined for “ANY”.

The Start Date defaults to “Today” but or a Date range of ±24 hours, yesterday, today and tomorrow, and past 30 days plus next 7 days.

The Update (automated polling) interval range for sending MWL queries is between 1 and 32,767 minutes, defaulting to 30 minutes.

# MEDIA STORAGE

## IMPLEMENTATION MODEL

### Application Data Flow



Figure 8
Application Data Flow Diagram for Media Storage

* The Media Application Entity exports Images to a removable storage medium. It is associated with the local real-world activity “Export” using the configured export selection parameters for selected patients’ data.

XPERIUS will support the use of USB devices.

An export to new media will include the following:

|  |  |
| --- | --- |
| 1 Format the media, creating a new Volume Label | 4 Create a folder for each patient |
| 2 Will export the “QVue” DICOM viewer | 5 Write a DICOMDIR file. |
| 3 Write an “Index.html” file to the media | 6 If a DICOMDIR already exists, the system will update. |

### Functional Definition of AEs

#### Functional Definition of Media Application Entity

Using ”Export” will pass the currently selected patients’ exams or individually selected images to the Media Application Entity. The contents of each export job will be written to the selected media destination. The size of the selected media is used to determine and display the number of media required for the export. When a device is filled to capacity, the system will prompt the user for addition media and continue.

### Sequencing of Real-World Activities

At least one image must exist and be selected before the Media Application Entity can be invoked. The operator can insert new media at any time. The Media Application Entity will wait indefinitely for media to be inserted before starting to write to the device.

### File Meta Information Options

The implementation information written to the File Meta Header in each file is:

Table 27

DICOM Implementation Class and Version for Media Storage

|  |  |
| --- | --- |
| Implementation Class UID | 1.3.46.670589.14.8200.150 |
| Implementation Version Name | XPERIUS\_1.5 |

## AE SPECIFICATIONS

### Media Application Entity Specification

The Media Application Entity provides standard conformance to the DICOM Interchange Option of the Media Storage Service Class. The Application Profiles and roles are listed in

Table 28

Application Profiles, Activities and Roles for Offline-Media

|  |  |  |  |
| --- | --- | --- | --- |
| Application Profiles Supported | Real World Activity | Role | SC Option |
| STD-GEN-USB-JPEG | Send to….Media | FSC / FSU | Interchange |

 **Transfer Syntax and Photometric Interpretation options for removable media**

|  |  |
| --- | --- |
| **Transfer Syntax** | **Photometric Interpretation** |
| RLE (Lossless) Compression | Palette Color |

#### File Meta Information for the Application Entity

The File-Set Identifier included in the File Meta Header is “”.

#### Real-World Activities

##### Activity – Send to Media – “Export”

The Media Application Entity acts as an FSC using the interchange option when requested to export SOP Instances from the local database to media.

The contents of the export job will be written together with a corresponding DICOMDIR to media. The user can cancel an export job in the job queue.

##### Activity – Update to Media – “Export”

The Media Application Entity acts as an FSU using the interchange option when requested to export SOP Instances from the local database to media upon which DICOM data already resides.

The system user selects exams from the system’s directory for transfer to media that already contains data. The DICOMDIR is updated allowing access to original and new data.

###### Media Storage Application Profiles

See Table 28 for supported Application Profiles.

###### Options

The Media Application Entity supports the SOP Classes and Transfer Syntaxes listed in Table 29.

Table 29

IODs, SOP Classes and Transfer Syntaxes for Offline­ Media

| Information Object Definition | SOP Class UID | Transfer Syntax | Transfer Syntax UID |
| --- | --- | --- | --- |
| Media Storage Directory Storage | 1.2.840.10008.1.3.10 | Implicit VR Little Endian | 1.2.840.10008.1.2 |
| US Image Storage | 1.2.840.10008.5.1.4.1.1.6.1 | RLE Lossless | 1.2.840.10008.1.2.5 |
| US Multiframe Image Storage | 1.2.840.10008.5.1.4.1.1.3.1 | RLE Lossless | 1.2.840.10008.1.2.5 |

**Directory Information Module**

All data elements are used as described in DICOM 3.0 Part 3 for Basic Directory Object Definitions. As stated in the Ultrasound Application Profile, “The (DICOMDIR) Directory shall include Directory Records of PATIENT, STUDY, SERIES, and IMAGE corresponding to the information object files in the File-set”. These are present when writing media.

Xperius ignores directory Record Types other than those above.

Xperius also ignores the “File-set consistency Flag” (0004,1212).

**Patient Directory Record**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute Name** | **Tag** | **Type** | **Usage** |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details. |
| Patient Name | (0010,0010) | 2 | Displayed to help the user identify the patient folder in which to place the studies for this patient. |
| Patient ID | (0010,0020) | 1 | Displayed to help the user identify the patient folder in which to place the studies for this patient. |

**Study Directory Record**

| **Attribute Name** | **Tag** | **Type** | **Usage** |
| --- | --- | --- | --- |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details. |
| Study Date | (0008,0020) | 1 | Used in displaying list of studies to user |
| Study Time | (0008,0030) | 1 | Used in displaying list of studies to user |
| Accession Number | (0008,0050) | 2 | Stored in the system database |
| Study Description | (0008,1030) | 2 | If available |
| Study Instance UID | (0020,000D) | 1C | Stored in the system database |
| Study ID | (0020,0010) | 1 | Stored in the system database |

**Series Directory Record**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute Name** | **Tag** | **Type** | **Usage** |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details. |
| Modality | (0008,0060) | 1 | Only US is supported. Other modalities are ignored. |
| Series Instance UID | (0020,000E) | 1 | Stored, when available |
| Series Number | (0020,0011) | 1 | Stored |

**Image Directory Record**

|  |  |  |  |
| --- | --- | --- | --- |
| **Attribute Name** | **Tag** | **Type** | **Usage** |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section 6 for details. |
| Instance Number | (0020,0013) | 1 | Used |
| Referenced File ID | (0004,1500) | 1C | Used |
| Referenced SOP Class UID in File | (0004,1510) | 1C | Used |
| Referenced SOP UID in File | (0004,1511) | 1C | Used |
| Referenced Transfer Syntax UID in File | (0004,1512) | 1C | Used |
| Content Date | (0008,0023) | 3 | Used for ordering the thumbnail display. On Export, comes from the image. |
| Content Time | (0008,0033) | 3 | Used for ordering the thumbnail display. On Export, comes from the image. |

# SUPPORT OF CHARACTER SETS

Table 26
Supported Character Sets

| Character Set Description | Defined Term | ESC Sequence | ISO Registration Number | Code Element | Character Set |
| --- | --- | --- | --- | --- | --- |
| Unicode as UTF-8 | ISO\_IR 192 | - | ISO-IR 192 | N/A | ISO 10646-1, 10646-2, and their associated supplements and extensions |
| - | ISO-IR 6 | G0 | ISO 646 |

# SECURITY

## General Security

Xperius incorporates an internal firewall that only accepts incoming traffic on the designated listening port, configured in Settings >DICOM>Change Settings>This System >System port number. The port is only opened if a server is defined.

## Supported DICOM Security Profiles

### TLS Secure Transport Connection Profiles

Basic TLS Secure Transport Connection Profile and the AES TLS Secure Transport Connection Profile are supported using Transport Layer Security Version 1.2 protocol with the following features:

|  |  |
| --- | --- |
| **Supported TLS Feature** | **Mechanism** |
| Entity Authentication | RSA based certificates |
| Exchange of Master Secrets | RSA |
| Data Integrity | SHA |
| Privacy (Cyphersuite Options) | TLS\_RSA\_WITH\_AES\_128\_CBC\_SHA (preferred)TLS\_RSA\_WITH\_3DES\_EDE\_CBC\_SHA |

TLS authentication may be used with or without TLS encryption – default is with TLS encryption.

For outgoing TLS requests where Xperius acts as a TLS Client, the received server RSA certificate is validated by verifying its digital signature against a certificate in the local Trusted Certificate Authorities store whose Subject matches the Issuer of the received certificate. If requested by the TLS Server, Xperius will then send the certificate configured for “This System” from the local Personal store.

For incoming TLS connection requests where Xperius acts as a TLS Server, the certificate configured for “This System” is sent from the Personal store to the client as specified in the TLS protocol. Xperius always requests a client certificate from the TLS Client.

Certificates are locally managed. The site administrator may import certificates from media to the Trusted Certificate Authority store for verifying incoming certificates; these may be either CA certificates or self-signed end-entity certificates. The site administrator may also import certificates from media to the Personal store along with the certificates private key for certificates representing ‘This System’. A wide variety of certificate file formats are supported, including

Base 64 Text: PEM format (.pem, .crt), usually unencrypted but may be encrypted. If encrypted, the encryption password must be provided when importing.

ASN.1 Binary: BER, DER, CER formats (.der, .cer, .crt)

PKCS#12: Encrypted Container for certificates with private keys (.pfx, .p12). This format is used primarily for the “This System” certificate with corresponding private key. The encryption password must be provided when importing.

PKCS#7: Container for multiple certificates. If there is only one certificate in the container, then the certificate is saved to the user-specified store name. If there are multiple certificates in the container, then the Issuer and Subject names of each certificate are compared; if the names are the same, the certificate is stored in the Trusted Certificate Authority store, else in the Intermediate Certificate Authority store.

The site administrator may also remove previously-imported certificates.

The incoming TCP port defaults to port 2762 when TLS security is enabled; this port may be changed by the user if desired.

# ANNEXES

## CREATED IOD INSTANCES

Table 31 specifies the attributes of an Ultrasound Image transmitted by the Xperius storage application.

The following tables use a number of abbreviations. The abbreviations used in the “Presence of …” column are:

VNAP Value Not Always Present (attribute sent zero length if no value is present)

ANAP Attribute Not Always Present

ALWAYS Always Present

EMPTY Attribute is sent without a value

The abbreviations used in the “Source” column:

MWL the attribute value source Modality Worklist

 Unless otherwise noted, values returned from worklist may be overridden by User input.

USER the attribute value source is from User input

AUTO the attribute value is generated automatically

CONFIG the attribute value source is a configurable parameter

### US or US Multiframe Image IOD

Table 31
IOD of created US or US Multiframe SOP Instances

| IE | Module | Reference | Presence of Module |
| --- | --- | --- | --- |
| Patient | Patient | Table 32 | ALWAYS |
| Study | General Study | Table 33 | ALWAYS |
| Patient Study | Table 34 | ALWAYS |
| Series | General Series | Table 35 | ALWAYS |
| Equipment | General Equipment | Table 36 | ALWAYS |
| Image | General Image | Table 37 | ALWAYS |
| Image Pixel | Table 38 | ALWAYS |
| Cine | Table 39 | Only if Multi-frame |
| Multi-frame | Table 40 | Only if Multi-frame |
| US Region Calibration | Table 41 | ANAP\* |
| US Image | Table 42 | ALWAYS |
| SOP Common | Table 43 | ALWAYS |

\* the US Region Calibration module is not present in US Multiframe images where a calibration change occurs, i.e. the loop contained a depth or zoom change.

### Common Modules

Table 32
Patient Module of created SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Patient’s Name | (0010,0010) | PN | Same attribute of MWL or PDE input | ALWAYS | MWL/USER/AUTO |
| Patient ID | (0010,0020) | LO | From MWL, user input or system generated.  | ALWAYS | MWL/USER/AUTO |
| Patient’s Birth Date | (0010,0030) | DA | Same attribute of MWL or PDE input | VNAP | MWL/USER |
| Patient’s Sex | (0010,0040) | CS | Same attribute of MWL or PDE input | ANAP | MWL/USER |

Table 33
General Study Module of created SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Study Instance UID | (0020,000D) | UI | Same value as in MWL or auto generated | ALWAYS | MWL/AUTO |
| Study Date | (0008,0020) | DA | Study’s Start Date  | ALWAYS | AUTO |
| Study Time | (0008,0030) | TM | Study’s Start Time  | ALWAYS | AUTO |
| Accession Number | (0008,0050) | SH | Same attribute of MWL  | VNAP | MWL |

Table 34
Patient Study Module of created SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Patient Size | (0010,1020) | DS | Same value as MWL attribute. | ANAP | MWL |
| Patient’s Weight | (0010,1030) | DS | Same value as MWL attribute. | ANAP | MWL |

Table 35
General Series Module of created image SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Modality | (0008,0060) | CS | “US” | ALWAYS | AUTO |
| Series Instance UID | (0020,000E) | UI | Auto generated. | ALWAYS | AUTO |
| Series Number | (0020,0011) | IS | A number unique within the Study | ALWAYS | AUTO |
| Performing Physician’s Name | (0008,1050) | PN | MWL Scheduled Performing Physician’s Name (0040,0006) or PDE input, ‘Physician’. | ANAP | MWL/USER |
| Operator’s Name | (0008,1070) | PN | MWL Scheduled Performing Physician’s Name (0040,0006) or PDE input, ‘Physician’. | ANAP | MWL/USER |

Table 36
General Equipment Module of created SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Manufacturer | (0008,0070) | LO | Philips  | ALWAYS | AUTO |
| Institution Name | (0008,0080 |  | User entry or default, “B|Braun Philips” | ALWAYS | USER/ AUTO |
| Station Name | (0008,1010) | SH | The AE Title of Xperius system on which the image is acquired. The user can configure the AE Title of the system through ‘Settings'. | VNAP | CONFIG |
| Software Version(s) | (0018,1020) | LO | This is a multi-valued tag which contains the following components:SW Part number, Version number, and SW build date  | ALWAYS | AUTO |
| Manufacturer’s Model Name | (0008,1090) | LO | ”XPERIUS” | ALWAYS | AUTO |

### US or Multiframe Image Modules

Table 37
General Image Module of created US SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Instance Number | (0020,0013) | IS | Generated by device, increments from “1” in each series. Gaps in values may exist if images are deleted on the system prior to export. | ALWAYS | AUTO |
| Patient Orientation | (0020,0020) | CS | The system sends the tag empty  | VNAP | AUTO |
| Content Date | (0008,0023) | DA | <yyyymmdd> | ALWAYS | AUTO |
| Content Time | (0008,0033) | TM | <hhmmss.ffffff> | ALWAYS | AUTO |
| Image Type | (0008,0008) | CS | DERIVED\PRIMARY\<Clinical application>; e.g.: MUSCULOSKELETAL | ALWAYS | AUTO |
| Acquisition Date | (0008,0022) | DT | The system uses the same value as the Content Date, tag 0008,0023. | ALWAYS | AUTO |
| Acquisition Time | (0008,0032) | TM | The system uses the same value as the Content time, tag 0008,0033. | ALWAYS | AUTO |
| Acquisition Datetime | (0008,002A) | DT | The system generates this as a combination of Acquisition Date and Acquisition Time. The format is yyyymmddhhmmss.ffffff | ALWAYS | AUTO |
| Lossy Image Compression | (0028,2110) | CS | “00”  | ALWAYS | AUTO |

Table 38
Image Pixel Module of created US or US Multiframe SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Samples per Pixel | (0028,0002) | US | 1 for PALETTE COLOR | ALWAYS | CONFIG |
| Photometric Interpretation | (0028,0004) | CS | PALETTE COLORMONOCHROME2 | ALWAYS | CONFIG |
| Rows | (0028,0010) | US | 600 | ALWAYS | CONFIG |
| Columns | (0028,0011) | US | 800 | ALWAYS | CONFIG |
| Bits Allocated | (0028,0100) | US |  2D B&W: 8 bits 2D Color: 16 bits | ALWAYS | AUTO |
| Bits Stored | (0028,0101) | US | Always the same numbers as Bits Allocated. | ALWAYS | AUTO |
| High Bit | (0028,0102) | US | The High Bit is always (Bits Allocated -1). | ALWAYS | AUTO |
| Pixel Representation | (0028,0103) | US | “0” pixels are Unsigned integers | ALWAYS | AUTO |
| Pixel Data | (7FE0,0010) | OW / OB |  | ALWAYS | AUTO |
| Red Palette Color Lookup Table Descriptor | (0028,1101) | US | Specifies the format of the Red Palette Color Lookup Table Data (0028,1201). | ALWAYS | AUTO |
| Green Palette Color Lookup Table Descriptor | (0028,1102) | US | Specifies the format of the Green Palette Color Lookup Table Data (0028,1201). | ALWAYS | AUTO |
| Blue Palette Color Lookup Table Descriptor | (0028,1103) | US | Specifies the format of the Blue Palette Color Lookup Table Data (0028,1201). | ALWAYS | AUTO |
| Red Palette Color Lookup Table Data | (0028,1201) | OW | The Red Palette Color Lookup Table Data. | ALWAYS | AUTO |
| Green Palette Color Lookup Table Data | (0028,1202) | OW | The Green Palette Color Lookup Table Data. | ALWAYS | AUTO |
| Blue Palette Color Lookup Table Data | (0028,1203) | OW | The Blue Palette Color Lookup Table Data. | ALWAYS | AUTO |

Table 39
Cine Module of created US Multiframe SOP

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Recommended Display Frame Rate | (0008,2144) | IS | Used for Multiframe | ALWAYS | AUTO |
| Cine Rate | (0018,0040) | IS | Used for Multiframe | ALWAYS | AUTO |
| Effective Duration | (0018,0072) | DS | Used for Multiframe | ALWAYS | AUTO |
| Frame Time Vector | (0018,1065) | DS | An array that contains the real time increments (in msec) between frames for a Multi-frame image. Present if Frame Increment Pointer (0028,0009) points to Frame Time Vector. | ALWAYS | AUTO |

Table 40
Multi-Frame Module of created US Multiframe SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Number of Frames | (0028,0008) | IS | # of frames in object | ALWAYS | AUTO |
| Frame Increment Pointer | (0028,0009) | AT | (0018,1065) Frame Time Vector | ALWAYS | AUTO |

Table 41
US Region Calibration Module of created US IMAGE or US Multiframe IMAGE SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Sequence of Ultrasound Regions | (0018,6011) | SQ | A sequence is present for each region on the system display | ANAP | AUTO |
| >Region Location Min x0 | (0018,6018) | UL | Top Left position of region.  | ANAP | AUTO |
| >Region Location Min y0 | (0018,601A) | UL | Top Left position of region | ANAP | AUTO |
| >Region Location Max x1 | (0018,601C) | UL | Bottom Right position of region | ANAP | AUTO |
| >Region Location Max y1 | (0018,601E) | UL | Bottom Right position of region | ANAP | AUTO |
| >Physical Units X Direction | (0018,6024) | US | Enumerated Value.  2D Image = 0003H = CM ECG Region = 0004H = Seconds | ANAP | AUTO |
| >Physical Units Y Direction | (0018,6026) | US | Enumerated Value.  2D Image = 0003H = CM  ECG Region = 0000H = None | ANAP | AUTO |
| >Physical Delta X | (0018,602C) | FD | The physical value per pixel increment | ANAP | AUTO |
| >Physical Delta Y | (0018,602E) | FD | The physical value per pixel increment | ANAP | AUTO |
| >Reference Pixel X0  | (0018,6020) | SL | The X pixel value of baseline | ANAP | AUTO |
| >Reference Pixel Y0  | (0018,6022) | SL | The Y pixel value of baseline | ANAP | AUTO |
| >Reference Pixel Physical Value X | (0018,6028) | FD | For each region, the X coordinate of the reference point for measurements within that region. | ANAP | AUTO |
| >Reference Pixel Physical Value Y | (0018,602A) | FD | For each region, the Y coordinate of the reference point for measurements within that region. | ANAP | AUTO |
| >Region Spatial Format | (0018,6012) | US | Enumerated Value. 2D (tissue or flow) = 0001H Wave form = 0004H | ANAP | AUTO |
| >Region Data Type | (0018,6014) | US | Enumerated Value.  Tissue = 0001H ECG Trace = 000AH | ANAP | AUTO |
| >Region Flags | (0018,6016) | UL | Always set to 3. | ANAP | AUTO |

Table 42
US Image Module of created US IMAGE or US Multiframe IMAGE SOP Instances

| Attribute Name | Tag | VR | Value | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Samples Per Pixel | (0028,0002) | US | See ‘Image Pixel Module’ | ALWAYS | AUTO |
| Photometric Interpretation | (0028,0004) | CS | See ‘Image Pixel Module’ | ALWAYS | CONFIG |
| Bits Allocated | (0028,0100) | US | See ‘Image Pixel Module’ | ALWAYS | AUTO |
| Bits Stored | (0028,0101) | US | See ‘Image Pixel Module’ | ALWAYS | AUTO |
| High Bit | (0028,0102) | US | See ‘Image Pixel Module’ | ALWAYS | AUTO |
| Planar Configuration | (0028,0006) | US | See ‘Image Pixel Module’ | ANAP | AUTO |
| Pixel Representation | (0028,0103) | US | “0” Pixels are Unsigned integers | ALWAYS | AUTO |
| Frame Increment Pointer | (0028,0009) | AT | (0018,1065) Frame Time Vector | ALWAYS | AUTO |
| Image Type | (0008,0008) | CS | See ‘General Image Module’ | ALWAYS | CONFIG |
| Lossy Image Compression | (0028,2110) | CS | “00”  | ALWAYS | AUTO |
| Ultrasound Color Data Present | (0028,0014) | US | 0 or 1 | ALWAYS | AUTO |
| Acquisition Datetime | (0008,002A) | DT | The date and time that the acquisition of data that resulted in this image started. | ALWAYS | AUTO |
| Transducer Data | (0018,5010) | LO | Transducer name. VM = 3, the last two fields are written as “UNUSED”. | ALWAYS | AUTO |
| Transducer Type | (0018,6031) | LO | LINEAR, CURVED LINEAR | ANAP | AUTO |
| Processing Function | (0018,5020) | LO | The factory-defined exam/preset that was active when the image was acquired even if a user-defined preset. | ALWAYS | AUTO |

Table 43
VOI LUT MODULE OF CREATED US SOP INSTANCES

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| Window Center | (0028,1050) | DS | Fixed at 128 | ALWAYS | AUTO |
| Window Width | (0028,1051) | DS | Fixed at 256 | ALWAYS | AUTO |

Table 44
SOP Common Module of created US IMAGE or US Multiframe IMAGE SOP Instances

| Attribute Name | Tag | VR | Value  | Presence of Value | Source |
| --- | --- | --- | --- | --- | --- |
| SOP Class UID | (0008,0016) | UI | 1.2.840.10008.5.1.4.1.1.6.1 for US Image1.2.840.10008.5.1.4.1.1.3.1 for US Multiframe Image | ALWAYS | AUTO |
| SOP Instance UID | (0008,0018) | UI | Auto Generated | ALWAYS | AUTO |
| Specific Character Set | (0008,0005) | CS | ISO\_IR 192 used for UTF-8 unicode characters, otherwise, ISO\_IR 100 | ALWAYS | AUTO |

### USED FIELDS IN RECEIVED IOD BY APPLICATION

Not Applicable

## ATTRIBUTE MAPPING

Table 45 summarizes the relationships between attributes received via MWL, stored in acquired images. The format and conventions used in Table 44 are the same as the corresponding table in DICOM Part 4, Annex M.6

Table 45
Attribute Mapping Between Modality Worklist, Image

| Modality Worklist | Image IOD |
| --- | --- |
| Patient’s Name | Patient’s Name |
| Patient ID | Patient ID |
| Patient’s Birth Date | Patient’s Birth Date |
| Patient’s Sex | Patient’s Sex |
| Patient’s Weight | Patient’s Weight |
| Study Instance UID | Study Instance UID |
| Accession Number | Accession Number |

## CONTROLLED TERMINOLOGY

Not applicable.

## EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

Not applicable.

\*\*\*\* End of Document \*\*\*\*\*

1. ® DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information. [↑](#footnote-ref-1)