



**BK Ultrasound**

## **DICOM Conformance Statement**

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For bkHub (Software Version 3.0.0 and higher)

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## CONFORMANCE STATEMENT OVERVIEW

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bkHub servers implement the necessary DICOM® SCP services to store Ultrasound (US) images and Structured Reports from the information systems, and forward them to peer SCPs. They also forward worklist queries from information systems to SCPs and send back the search results.

The following table provides an overview of the network service (SOP) classes supported by BK Ultrasound.

**Table: Network Services**

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
<b>Transfer</b>		
US Image Storage	Yes	Yes
US Multi-frame Image Storage	Yes	Yes
Comprehensive SR	Yes	Yes
<b>Workflow Management</b>		
Modality Worklist Information Model – FIND	Yes	Yes

The SOP Classes are categorized as follows:

**Table: UID Values**

UID Value	UID Name	Category
1.2.840.10008.5.1.4.1.1.6.1	US Image Storage	Transfer
1.2.840.10008.5.1.4.1.1.6. (Retired)	US Image Storage	Transfer
1.2.840.10008.5.1.4.1.1.3.1	US Multi-frame Image Storage	Transfer
1.2.840.10008.5.1.4.1.1.3 (Retired)	US Multi-frame Image Storage	Transfer
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR	Transfer
1.2.840.10008.5.1.4.31	Modality Worklist Information Model – FIND	Workflow Management

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## REVISION HISTORY

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Version	Date	Author	Description
00	October 10, 2014	Bill Zhang Tomas Bobovsky	Initial draft of the bkHub-specific DICOM Conformance Statement
00	May 28, 2015	Sissel Bagge	Updated for bkHub 3.0.0
01	January 21, 2016	Alison Craig	Updates for bkHub 3.0.2

# CHAPTER 1: INTRODUCTIONS

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This document is the DICOM Conformance Statement for bkHub systems (software version 3.0.0 and higher).

The system conforms to the DICOM 3.0 standard to share medical information with other digital imaging systems. The bkHub system, by means of the DICOM protocol, communicates with Storage, and Modality Worklist. The bkHub is capable of receiving and forwarding images and Structured Reports (SR) that conform to the Composite IOD. The bkHub also has the ability to poll Modality Worklists from multiple SCPs and send the received items to querying SCUs.

## 1.1 AUDIENCE

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

## 1.2 REMARKS

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

## 1.3 TERMS AND DEFINITIONS

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

**Table 1-1: Terms and Definitions**

Term	Definition
<b>Abstract Syntax</b>	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, Ultrasound Image Storage SOP Class.
<b>Application Entity (AE)</b>	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.
<b>Application Entity Title</b>	The externally known name of an <i>Application Entity</i> , used to identify a DICOM application to other DICOM applications on the network.
<b>Application Context</b>	The specification of the type of communication used between <i>Application Entities</i> . Example: DICOM network protocol.
<b>Association</b>	A network communication channel set up between Application Entities.
<b>Attribute</b>	A unit of information in an object definition; a data element identified by a <i>tag</i> . 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).

<b>Information Object Definition (IOD)</b>	The specified set of <i>Attributes</i> 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 <i>Attributes</i> 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). Example: US Image IOD.
<b>Joint Photographic Experts Group (JPEG)</b>	A set of standardized image compression techniques, available for use by DICOM applications.
<b>Media Application Profile</b>	The specification of DICOM information objects and encoding exchanged on removable media (e.g., CDs).
<b>Module</b>	A set of <i>Attributes within an Information Object Definition</i> that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, and Patient Sex.
<b>Negotiation</b>	First phase of <i>Association</i> establishment that allows <i>Application Entities</i> to agree on the types of data to be exchanged and how that data will be encoded.
<b>Presentation Context</b>	The set of DICOM network services used over an Association, as negotiated between <i>Application Entities</i> ; includes <i>Abstract Syntaxes</i> and <i>Transfer Syntaxes</i> .
<b>Protocol Data Unit (PDU)</b>	A packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.
<b>Security Profile</b>	A set of mechanisms, such as encryption, user authentication, or digital signatures, used by an <i>Application Entity</i> to ensure confidentiality, integrity, and/or availability of exchanged DICOM data.
<b>Service Class Provider (SCP)</b>	Role of an <i>Application Entity</i> that provides a DICOM network service; typically, a server that performs operations requested by another <i>Application Entity (Service Class User)</i> . Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).
<b>Service Class User (SCU)</b>	Role of an <i>Application Entity</i> that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU).
<b>Service/Object Pair (SOP) Class</b>	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.
<b>Service/Object Pair (SOP) Instance</b>	An information object; a specific occurrence of information exchanged in a <i>SOP Class</i> . Examples: a specific US image.
<b>Tag</b>	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], (0043,1050) [private data element].
<b>Transfer Syntax</b>	The encoding used for exchange of DICOM information objects and messages. Examples: <i>JPEG</i> compressed (images), little endian explicit value representation.
<b>Unique Identifier (UID)</b>	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.
<b>Value Representation (VR)</b>	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.



## 1.4 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.

## 1.5 ABBREVIATIONS

<b>AE</b>	Application Entity	<b>MSPS</b>	Modality Scheduled Procedure Step
<b>AET</b>	Application Entity Title	<b>MWL</b>	Modality Worklist
<b>DHCP</b>	Dynamic Host Configuration Protocol	<b>PDU</b>	Protocol Data Unit
<b>DICOM</b>	Digital Imaging and Communications in Medicine	<b>SCP</b>	Service Class Provider
<b>DNS</b>	Domain Name System	<b>SCU</b>	Service Class User
<b>IOD</b>	Information Object Definition	<b>SOP</b>	Service-Object Pair
<b>JPEG</b>	Joint Photographic Experts Group	<b>SPS</b>	Scheduled Procedure Step
<b>LUT</b>	Look-up Table	<b>SR</b>	Structured Reporting
<b>MPEG</b>	Moving Picture Experts Group	<b>TCP/IP</b>	Transmission Control Protocol/Internet Protocol
<b>MPPS</b>	Modality Performed Procedure Step	<b>US</b>	Ultrasound

## 1.6 REFERENCES

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>

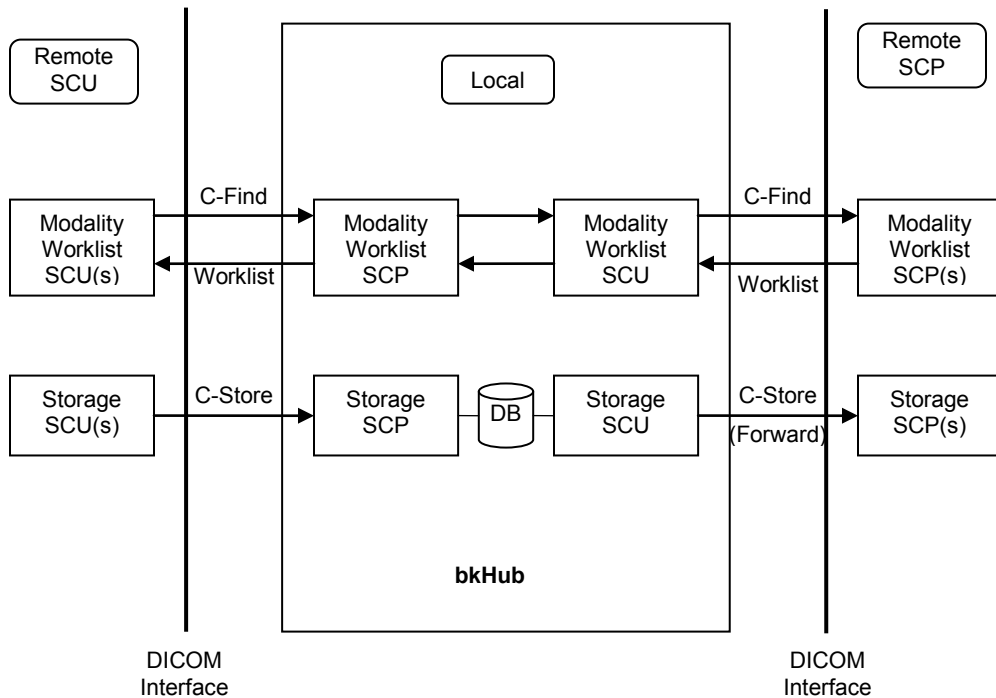
## 2.1 IMPLEMENTATION MODEL

The bkHub exposes the DICOM 3.0 standard as both SCP and SCU for Image and Comprehensive SR Storage and Modality Worklist.

### 2.1.1 Application Data Flow

**Figure 2-1** depicts the relationship between real-world activities and their corresponding local and remote Application Entities.

**Figure 2-1: Implementation Model**



- The local Modality Worklist (MWL) SCP receives Worklist query (C-Find) from a remote MWL SCU and triggers the local MWL SCU to send a request to the configured remote MWL SCP(s). After the worklist items are received on local MWL SCU, the local MWL SCP is notified to provide the set of worklist items matching the query request back to the initial remote MWL SCU.
- The local Storage SCP receives images from a remote SCU AE, and saves them to the database. Based on configuration, the local Storage SCU can automatically forward the images to one or more connected remote Storage SCP(s).

## **2.1.2 Functional Definitions of AE's**

### **2.1.2.1 Functional Definition of Worklist Application Entity**

The Worklist AE supports the DICOM Basic Worklist Management Service as both SCP and SCU. The WML SCU manages the retrieval of Worklist items from configured multiple DICOM Worklist Servers. The WML SCP then sends the matching Worklist items to the remote client responding to a user specified query.

Upon receiving a Worklist C-FIND request from a remote node, the local MWL SCP establishes an association to the remote AE, and initiates the local MWL SCU to refresh the worklist items by connecting to each of the configured Worklist SCP(s). The local WML SCP will then filter out the returned results using the provided search keys and transfer the matching records back to the remote node via the open Association.

During receiving the worklist response, the local MWL SCU counts the items and the query processing is canceled if the configurable limit of overall items is reached. Note that each remote Worklist server might have its own limit of maximum number of responses. Besides the maximum number of Worklist items to retrieve, the local WML SCU can also be set to limit the Modality and the range of dates from the current date (before and/or forward) for query via DIOM Settings on DICOM Worklist devices.

The following search parameters are supported by bkHub WML SCP:

- Scheduled Procedure Step Sequence
- Scheduled Station AE Title
- Scheduled Procedure Step Start Date
- Scheduled Procedure Step Start Time
- Modality
- Scheduled Performing Physicians Name
- Scheduled Procedure Step Description
- Patients Name
- Patient ID
- Accession Number
- Requested Procedure ID
- Referring Physicians Name
- Patients Sex
- Requesting Physician
- Admission ID
- Requested Procedure Priority
- Requested Procedure Description
- Patients Birth Date

### **2.1.2.2 Functional Definition of Storage Application Entity**

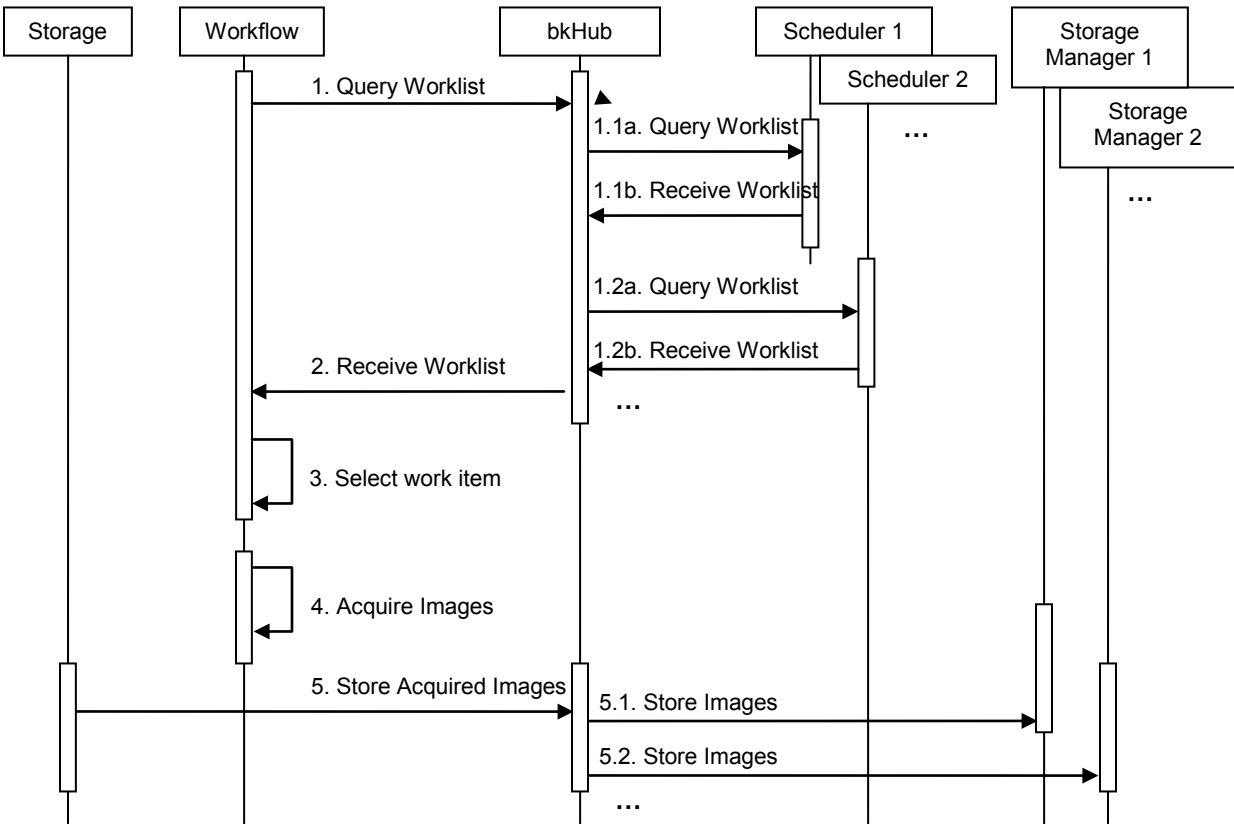
The Storage AE supports the DICOM Store Service as both SCP and SCU. The storage SCP receives and saves the various DICOM images and SRs on the local database and the Storage SCU manages the forwarding of those stored DICOM objects to the configured DICOM Storage Servers.

Once an association request is received, the bkHub Storage SCP rejects the association if the proposed transfer syntaxes are not accepted for the specified abstract syntaxes. Otherwise, it accepts and acknowledges the association then receives and processes the incoming C-STORE request commands.

The stored objects can be forwarded to other remote Storage SCPs automatically or manually sent at a later time.

### 2.1.3 Sequencing of Real-World Activities

Figure 2-2: Sequencing of Real-World Activities



Under normal scheduled workflow conditions the sequencing constraints illustrated in above Figure apply:

1. Query Worklist
  - 1.1a. Query Worklist from the first scheduler
  - 1.1b. Receive Worklist from the first scheduler
  - 1.2a. Query Worklist from the second scheduler
  - 1.2b. Receive Worklist from the second scheduler
2. Receive overall matching Worklist
3. Select work item from Worklist
4. Acquire Images
5. Store acquired images
  - 5.1. Store images to the first Storage server
  - 5.2. Store images to the second Storage server

Other workflow situations (e.g. unscheduled procedure steps) will have other sequencing constraints.

## 2.2 AE SPECIFICATIONS

### 2.2.1 Storage Application Entity Specification

The Storage AE provides conformance to the following DICOM SOP Classes:

**Table 2-1: SOP Class Conformance as SCU and SCP**

SOP Class Name	SOP Class UID	SCU	SCP
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Yes	Yes
US Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Yes	Yes
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Yes	Yes
US Multi-Frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Yes	Yes
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Yes	Yes
Verification	1.2.840.10008.1.1	Yes	Yes

#### 2.2.1.1 Association Policies

##### 2.2.1.1.1 General

**Table 2-2: Maximum PDU Size Received as a SCP**

Maximum PDU size received	131072 bytes
---------------------------	--------------

The default PDU size for SCU is 16 384 bytes.

##### 2.2.1.1.2 Number of Associations

**Table 2-3: Number of Associations as a SCP**

Maximum number of simultaneous associations	Unlimited (system configuration limit - CPU, Memory, Network)
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**Table 2-4: Number of Associations as a SCU**

Maximum number of simultaneous associations	1
---	---

##### 2.2.1.1.3 Asynchronous Nature

bkHub Storage SCP and Storage SCU will only allow a single outstanding operation on an Association. Therefore, it will not perform any asynchronous operations.

##### 2.2.1.1.4 Implementation Identifying Information

**Table 2-5: DICOM Implementation Class and Version**

Implementation Class UID	2.16.124.113577.1.0.3.5.5
Implementation Version name	SONIX_DCMTK_355

#### 2.2.1.2 Association Initiation Policy

bkHub Storage SCP does not initiate associations.

bkHub Storage SCU attempts to initiate a new association for a set of instances in the Storage queue targeted to the same remote AE it attempts to forward to.

#### **2.2.1.2.1 Activity – Forward: Send Storage Request Description and Sequencing of Activities**

User can setup automatic forwarding by populating and enabling Storage DICOM device(s) and configuring forwarding criteria, or manually select exams and forward them to configured DICOM servers. Exams are placed on DICOM forward queue, which is processed periodically. The bkHub Storage SCU initiates associations to remote Storage Servers sequentially when the DICOM Forward queue is being processed. Associations are initiated periodically to transfer images that were previously unsuccessfully forwarded.

With automatic forwarding enabled when an image is received an association is initiated to transfer the image. Once the image has been transferred then the association is closed. If the image is unsuccessfully transferred then attempts to initiate and transfer the image shall be made periodically.

Similar to images, once the SR has been transferred then the association is closed and attempts are made periodically to re-transmit in case of failure. SR(s) are also sent when the user manually selects exams to send to DICOM Storage Server.

#### **2.2.1.2.2 Association Initiation by: Manual Store**

The user can manually select previously acquired exams and send them to configured Storage Servers sequentially which invoke the opening of an association.

SR(s) are also transferred for those selected exams.

#### **2.2.1.2.3 Association Initiation by: Storage Retry**

Attempts to send images and SR's that were previously unsuccessfully transferred to a Storage Server are made periodically. Each attempt initiates an association.

#### **2.2.1.3 Association Acceptance Policy**

bkHub Storage SCU does not accept associations.

When bkHub Storage SCP accepts an association, it will respond to storage requests. If the contexts with proposed transfer syntaxes are not supported, the association will be rejected.

### 2.2.1.4 Proposed Presentation Context to a Storage Server

The following list applies when bkHub Storage SCU is configured to forward images/SR's to Storage Servers:

**Table 2-6: Proposed Presentation Contexts**

Abstract Syntax		Transfer Syntax			
Name	UID	Name	UID	Role	Extended Negotiation
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Table 2-7		SCU	None
US Image Storage (retired)	1.2.840.10008.5.1.4.1.1.6	Table 2-7		SCU	None
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Table 2-7		SCU	None
US Multi-Frame Image Storage (retired)	1.2.840.10008.5.1.4.1.1.3	Table 2-7		SCU	None
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Table 2-7		SCU	None

**Table 2-7: Storage AE Supported Transfer Syntaxes**

Name	UID
DICOM Implicit VR Little Endian	1.2.840.10008.1.2
DICOM Explicit VR Little Endian	1.2.840.10008.1.2.1
JPEG Baseline (Process 1): Lossy JPEG 8 Bit Image Compression	1.2.840.10008.1.2.4.50
JPEG Lossless (Process 14)	1.2.840.10008.1.2.4.57
JPEG Lossless (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70
RLE Lossless	1.2.840.10008.1.2.5

#### 2.2.1.4.1 SOP Specific Conformance to Ultrasound Storage SOP Class

bkHub stores all DICOM attributes for all images and SR's received. There are certain attributes which are stored in defined record locations in the database.

The following table describes attributes that are stored and used by bkHub when image or SR is received from a storage SCU.

**Table 2-8: Significant Patient Module Attributes**

Attribute Name	Tag ID	Comment
Patient Name	(0010,0010)	Stored in bkHub patient record. Names are set using carat, '^', delimiters.
Patient ID	(0010,0020)	Stored in bkHub patient record. If received Patient ID is blank then it defaults to "UNKNOWN".
Patient's Birth Date	(0010,0030)	Stored in bkHub patient record.
Patient's Sex	(0010,0040)	Stored in bkHub patient record.

**Table 2-9: Significant General Study Module Attributes**

Attribute Name	Tag ID	Comment
Study Instance UID	(0020,000D)	Stored in bkHub exam record.
Study Date	(0008,0020)	Stored in bkHub exam record.
Study Time	(0008,0030)	Stored in bkHub exam record.
Study ID	(0020,0010)	Stored in bkHub exam record.
Accession Number	(0008,0050)	Stored in bkHub exam record.
Study Description	(0008,1030)	Stored in bkHub exam record.
Operator's Name	(0008,1070)	Stored in bkHub exam record.
Performing Physician Name	(0008,1050)	Stored in bkHub exam record.

**Table 2-10: Significant General Series Module Attributes**

Attribute Name	Tag ID	Comment
Modality	(0008,0060)	Stored in bkHub exam files record.
Series Date	(0008,0021)	Stored in bkHub exam files record if Instance Creation Date is empty.
Series Time	(0008,0031)	Stored in bkHub exam files record if Instance Creation Time is empty.
Instance Creation Date	(0008,0012)	Stored in bkHub exam files record.
Instance Creation Time	(0008,0013)	Stored in bkHub exam files record.
SOP Instance UID	(0008,0018)	Stored in bkHub DICOM files record.

**Table 2-11: Significant General Equipment Module Attributes**

Attribute Name	Tag ID	Comment
Manufacturer	(0008,0070)	Stored in bkHub devices record.
Institution Name	(0008,0080)	Stored in bkHub stations record.
Station Name	(0008,1010)	Stored in bkHub stations record.
Manufacturer's Model Name	(0008,1090)	Stored in bkHub devices record.
Software Version	(0018,1020)	Stored in bkHub devices record.

**Table 2-12: Significant General Image Module Attributes**

Attribute Name	Tag ID	Comment
Derivation Description	(0008,2111)	Stored in bkHub image metadata record.

**Table 2-13: Significant Image Pixel Module Attributes**

Attribute Name	Tag ID	Comment
Samples per pixel	(0028,0002)	Stored in bkHub image metadata record.
Photometric Interpretation	(0028,0004)	Stored in bkHub image metadata record.
Rows	(0028,0010)	Stored in bkHub image metadata record.
Columns	(0028,0011)	Stored in bkHub image metadata record.
Bits Allocated	(0028,0100)	Stored in bkHub image metadata record.
Bits Stored	(0028,0101)	Stored in bkHub image metadata record.
High bit	(0028,0102)	Stored in bkHub image metadata record.
Pixel Data	(7FE0,0010)	Stored in bkHub file data record.
Planar Configuration	(0028,0006)	Stored in bkHub image metadata record.



**Table 2-14: Significant Cine Module Attributes**

Attribute Name	Tag ID	Comment
Frame Time	(0018,1063)	Stored in bkHub image metadata record.
<b>Recommended</b> Display Frame Rate	(0008,2144)	Used for playback.
Cine Rate	(0018,0040)	Used for playback.

**Table 2-15: Significant Multi-Frame Module Attributes**

Attribute Name	Tag ID	Comment
Number of Frames	(0028,0008)	Used for playback.

**Table 2-16: Significant US Region Calibration Module Attributes**

Attribute Name	Tag ID	Comment
Region Location Min $x_0$	(0018,6018)	Used for measure.
Region Location Min $y_0$	(0018,601A)	Used for measure.
Region Location Min $x_1$	(0018,601C)	Used for measure.
Region Location Min $y_1$	(0018,601E)	Used for measure.

**Table 2-17: Storage C-STORE Status Error Codes**

Service Status	Message	Error Code	Behavior
Success	Success	0000	The SCP has successfully stored the SOP instance.
Refused	SOP Class Not Suported	A800	The status is logged in bkHub DICOM logs and association is aborted using A-ABORT.
Error	Dataset Does Not Match SOP Class	A900	The status is logged in bkHub DICOM logs and association is aborted using A-ABORT.
Error	Cannot Understand	C000	The status is logged in bkHub DICOM logs and association is aborted using A-ABORT.
Warning	Coercion Of Data Elements	B000	The status is logged in bkHub DICOM logs.
Warning	Dataset Does Not Match SOP Class	B007	The status is logged in bkHub DICOM logs
Warning	Elements Discarded	B006	The status is logged in bkHub DICOM logs

## 2.2.2 Modality Worklist Application Entity - Specification

The Modality Worklist AE provides conformance to the following DICOM SOP Classes as an SCP and SCU:

**Table 2-18: SOP Class Conformance as SCP and SCU**

SOP Class Name	SOP Class UID	Conformance Level
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	<b>Standard</b>

### 2.2.2.1 Association Establishment Policies

bkHub Worklist SCU uses C-FIND query to retrieve Worklist items from configured multiple Worklist Servers and stores the received Worklist data in a database. bkHub Worklist SCU initiates associations with the Worklist Servers sequentially. bkHub Worklist SCU performs a C-FIND query periodically or when a request is made by bkHub Worklist SCP. The default timeout period between C-FIND queries is 20 minutes.

bkHub Worklist SCP acts as a Worklist forwarder and does not initiate associations. bkHub Worklist waits for Worklist Clients to initiate an association and receive a C-FIND query request. This request is then sent by bkHub Worklist SCU to configured Worklist Servers. Worklist item results are returned back to the Worklist Clients.

#### 2.2.2.1.1 General

The default PDU size is 16 384 bytes. The PDU size is configurable by the user.

#### 2.2.2.1.2 Number of Associations

**Table 2-19: Number of Associations as a Worklist SCP**

Maximum number of simultaneous associations	Unlimited (system configuration limit - CPU, Memory, Network)
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**Table 2-20: Number of Associations as a Worklist SCU**

Maximum number of simultaneous associations	1
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**Note:** Each Worklist SCP can create 1 Worklist SCU association.

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#### 2.2.2.1.3 Asynchronous Nature

bkHub Worklist SCP and SCU will only allow a single outstanding operation on an Association. Therefore, it will not perform any asynchronous operations.

#### 2.2.2.1.4 Implementation Identifying Information

**Table 2-21: DICOM Implementation Class and Version**

Implementation Class UID	2.16.124.113577.1.0.3.5.5
Implementation Version name	SONIX_DCMTK_355

### 2.2.2.2 Association Initiation by: Real-World Activity

The Modality Worklist AE initiates an association to Modality Worklist Server periodically or when ultrasound machine issues C-FIND query request to bkHub Worklist SCP.

#### 2.2.2.2.1 Association Initiation by: Worklist Search

On the ultrasound machine the user can specify Worklist search parameters. The user then performs a search that initiates an association upon which a query built with these parameters is issued to the bkHub Worklist SCP. bkHub Worklist SCP will forward this query to configured Worklist Servers and return the results back to the ultrasound machine.

#### 2.2.2.3 Proposed Presentation Context to a Modality Worklist Server

The following list applies when bkHub is configured to retrieve Worklist from a Worklist Server:

**Table 2-22: Proposed Presentation Contexts**

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Modality Worklist Information Model - FIND	1.2.840.10008.5.1.4.31	DICOM Implicit VR Little Endian	1.2.840.10008.1.2	SCU SCP	None

#### 2.2.2.3.1 SOP Specific Conformance to Modality Worklist Service SOP Classes

The following attributes are used to find a match by the bkHub Worklist SCP.

**Table 2-23: Worklist Query Attributes**

Attribute Name	Tag ID	Comment
Scheduled Procedure Step Start Date	(0040,0002)	Single date matching or date range matching
Scheduled Procedure Step Start Time	(0040,0001)	Single time matching or time range matching
Modality	(0040,0060)	Single value matching
Scheduled Performing Physician's Name	(0040,0006)	Single value matching or wildcard matching
Scheduled Procedure Step Description	(0040,0007)	Single value matching or wildcard matching
Scheduled Station AE Title	(0040,0001)	Single value matching
Requested Procedure ID	(0040,1001)	Single value matching or wildcard matching
Requested Procedure Priority	(0040,1003)	Single value matching or wildcard matching
Requested Procedure Description	(0032,1060)	Single value matching or wildcard matching
Accession Number	(0008,0050)	Single value matching or wildcard matching
Patient Name	(0010,0010)	Single value matching or wildcard matching
Patient ID	(0010,0020)	Single value matching
Patient Birth Date	(0010,0030)	Single date matching or date range matching
Patient Sex	(0010,0040)	Single value matching or wildcard matching
Referring Physician's Name	(0008,0090)	Single value matching or wildcard matching
Requesting Physician	(0032,1032)	Single value matching or wildcard matching
Admission ID	(0038,0010)	Single value matching or wildcard matching

## 2.3 COMMUNICATION PROFILES

### 2.3.1 Supported Communication Stacks

The bkHub AE provides DICOM 3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

### 2.3.2 TCP/IP

The bkHub AE inherits its TCP/IP stack from the Windows operating system upon which it executes.

#### 2.3.2.1 Physical Media Support

The bkHub AE is indifferent to the physical medium over which TCP/IP executes as it inherits this support from the Windows operating system upon which it executes.

## 2.4 CONFIGURATION

### 2.4.1 AE Title/Presentation Address Mapping

The mapping from AE Title to TCP/IP addresses and ports is configurable.

#### 2.4.1.1 Local AE Title

Local AE Title (for DICOM SCU) is configured using Windows Registry. The default value is the computer hostname. Most of the time there is no need to change local AE Title.

#### 2.4.1.2 Called AE Title

Called AE Title (for remote SCP) is configured for every DICOM SCU device.

### 2.4.2 Configurable Parameters

bkHub DICOM settings can be modified with configurable parameters. The sections below provide descriptions of these parameters.

#### 2.4.2.1 DICOM AE

bkHub DICOM AE parameters are configured using Windows Registry. The defaults are sufficient in most cases don't need to be modified.

The configurable parameters are:

- Station Name (Default: Computer hostname)
- Local AE Title (Default: Computer hostname)
- Port (Default: 104)

#### 2.4.2.2 Remote DICOM Servers

One or more remote DICOM devices can be added and configured. Device can be of type Storage (DICOM SCP) or Worklist (DICOM Worklist). The following parameters are configurable for every added device in bkHub client:

- Host Address
- Host Port (Default: 104)
- AE Title
- Host Type (Storage, Worklist)

### **2.4.2.3 DICOM Modality Worklist Configuration**

DICOM Worklist has several configurable parameters which can improve performance or retrieve a larger sample of worklist items. These parameters apply to bkHub Worklist SCU performing C-FIND query on remote Worklist SCP.

- Maximum number of worklist items to retrieve (Default: 500)
- Modality (Default: US)
- Retrieve worklist for today only (fast performance) (Default: No)
- Retrieve worklist form # days ago (slow performance) (Default: 35)
- Retrieve worklist up to # days forward (slow performance) (Default: 7)

### **2.4.2.4 DICOM Forward Configuration**

bkHub DICOM can be configured to automatically forward exams to a remote server based on certain criteria which can be configured with the following parameters.

- Mandatory Accession Number on Forward
- Mandatory Date of Birth on Forward
- Mandatory First Name on Forward
- Mandatory Last Name on Forward
- Mandatory Sex on Forward

## CHAPTER 3: SUPPORT OF CHARACTER SETS

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ISO\_IR 100 (Latin No. 1) is always used.

No support for other Extended Character Sets is provided.

## CHAPTER 4: SECURITY

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DICOM security is not implemented on the bkHub in this release.

## **APPENDIX A: ANNEXES**

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### **A.1 IOD CONTENTS**

Not applicable.

### **A.2 COMPREHENSIVE STRUCTURED REPORT IOD**

Not applicable.

### **A.3 DATA DICTIONARY OF PRIVATE ATTRIBUTES**

Not applicable.

### **A.4 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS**

Not applicable.

### **A.5 STANDARD EXTENDED/SPECIALIZED/PRIVATE SOPS**

Not applicable.

### **A.6 PRIVATE TRANSFER SYNTAXES**

Not applicable.