

PUBLIC

iQ-WORKLIST

ADMINISTRATION GUIDE

Version 2.0.0 PUB INT EN 009R

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1 INTRODUCTION

iQ-WORKLIST is used to provide patient and study information to DICOM compatible imaging devices (modalities) within a radiological network. It can receive data in various formats (HL7, GDT, proprietary text files) and automatically convert it into a generalized format. On request, the application can return data to the modalities and can inform other participants in the network (e.g. RIS, HIS, EMR, or PACS) about performed procedures and their respective statuses (In progress, Complete, Discontinued).

In order to meet the needs and expectations of most end-users, iQ-WORKLIST is available in three versions: BASIC, PRO and PREMIUM.

The BASIC version supports a maximum of 2 DICOM nodes and is optimized for smaller imaging centers or doctors' offices.

The PRO version supports a maximum of 10 DICOM nodes and is optimized for normal-sized imaging centers or smaller hospitals.

The PREMIUM version supports an unlimited number of DICOM nodes and is able to manage the DICOM modality worklist of larger hospitals.

2 SYSTEM REQUIREMENTS

2.1 MINIMUM SYSTEM REQUIREMENTS

SPECIFICATION	MINIMUM
Processor	Single Core 2.0 GHz
Main Memory	1024 MB
Hard Disk	20 GB free hard disc space
Network	100 Mbit/s
Graphics	-
Operating System	Windows XP Professional with SP3 (only as an upgrade for currently running iQ-WORKLIST 1.x versions), 32 bit only Windows 7 Professional (or higher edition) with SP1, 32 or 64 bit Windows 8/8.1 Professional (or higher edition), 32 or 64 bit Windows 10 Pro (or higher edition), 32 or 64 bit Windows Server 2008 R2 Standard or Enterprise with SP1, 32 or 64 bit Windows Server 2012 Standard, 64 bit Windows Server 2012 R2 Standard, 64 bit Windows Server 2016 Standard, 64 bit

2.2 RECOMMENDED SYSTEM REQUIREMENTS

SPECIFICATION	RECOMMENDED
Processor	Dual or Multi Core 1.8 GHz or higher
Main Memory	2048 MB or higher
Hard Disk	120 GB free hard disc space
Network	1 GBit/s or higher
Graphics	-
Operating System	Windows Server 2008 R2 Enterprise with SP1, 32 or 64 bit Windows Server 2012 R2 Standard, 64 bit Windows Server 2016 Standard, 64 bit

In addition, we recommend the use of up-to-date anti-virus software on the computer on which iQ-WORKLIST is running. The virus definitions should be updated regularly and should not be older than 2 weeks.

To keep the power supply voltage constant, we recommend the use of an uninterruptible power supply (UPS). The interposition of such a device prevents data loss and data inconsistencies that may occur as a result of fluctuations in the power supply.

3 INSTALLING THE SOFTWARE

3.1 INSTALLATION

NOTE:

The setup file installs the new version of iQ-WORKLIST only. Due to the big differences in the configuration files and databases, it will not update an existing installation of iQ-WORKLIST <= version 1.5.

To install the application, do the following:

- Download and save the iQ-WORKLIST setup file to a local directory of your choice.
- Run the setup file and follow the instructions of the installation wizard.

The application runs in trial mode for a period of 30 days, allowing access for up to 10 DICOM nodes.

During installation, the application is registered as a Windows NT Service called "iQ-WORKLIST Service."

3.2 FIRST STEPS AFTER INSTALLATION

The application runs as a Windows NT Service after installation. Thus, it starts on system start up and stops on system shut down.

The default configuration after installation is as follows: iQ-WORKLIST listens on port 104 for DICOM communication. Its AETitle is "IQWL" and any incoming DICOM communication from DICOM nodes other than "REMOTEAE" is rejected. iQ-WORKLIST also listens on port 2100 for incoming HL7 messages. A file-based HL7 message will not be processed automatically. The data mapping of incoming HL7 messages can be implemented as described in the HL7 Conformance Statement.

If one of the ports is blocked by another application or the AETitle of the modality is not "REMOTEAE," these default settings must be adapted for iQ-WORKLIST to function properly in your environment. The list below shows the most common changes needed before the application can be used in a productive setting.

- Chapter 9.1.2: Change DICOM port and AETitle
- Chapter 9.1.2.1: Change accepted DICOM nodes
- Chapter 9.1.3: Change HL7 port
- Chapter 9.1.3: Change way of HL7 communication
- Chapter 9.3 and 9.4: Change data mapping or dictionaries

3.3 UPGRADING IQ-WORKLIST

An automatic upgrade from an older version of iQ-WORKLIST to 2.0 is not possible. However, both versions may be installed at the same time. The configuration of the old iQ-WORKLIST version can then be merged manually with the new version.

Merging the configuration is a two-step process:

1. Merge the system configuration such as:
 - a. DICOM configuration (see 9.1.2)
 - b. HL7 configuration (see 9.1.3)
2. Merge the HL7 mapping and/or other formats (such as GDT):
 - a. HL7 mapping (see 9.3.1)
 - b. Other formats (see 9.3.2)

3.3.1 UPGRADING THE LICENSE

Keep in mind that the license valid for one software version will not work on a newer software version. This means that after installation, the new version can only be used for the default 30 day trial period until a new, full license is installed.

NOTE:

Upgrade fees may apply for a software upgrade. In addition, specific licensing procedures will need to be observed before the new license can be delivered. Therefore, please contact your local reseller for instructions BEFORE upgrading your software.

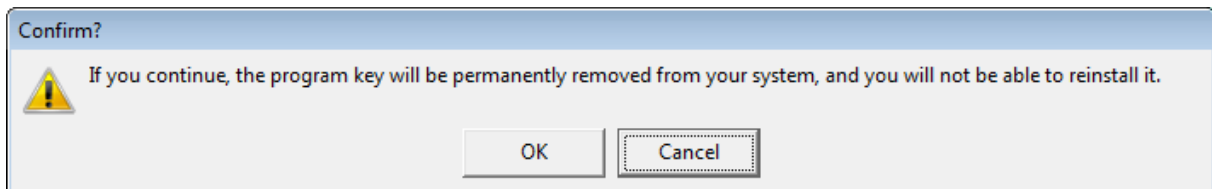
4 UNINSTALLING THE SOFTWARE

Follow the steps below to remove iQ-WORKLIST from the computer:

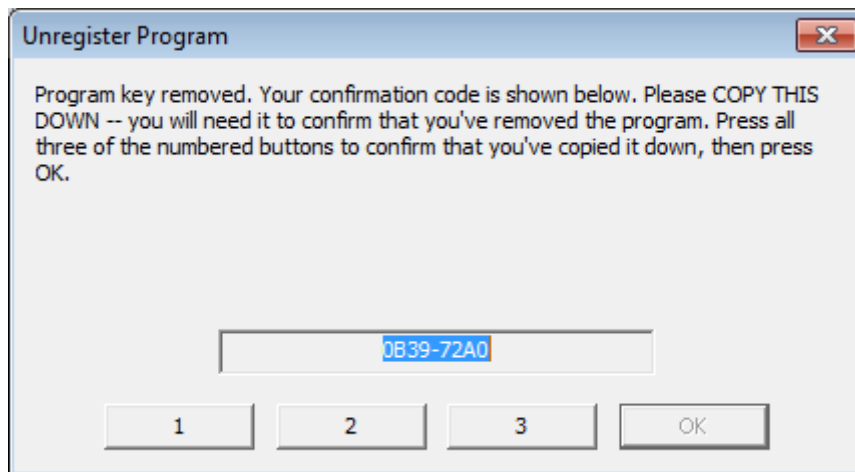
4.1 RESET THE LICENSE

Before uninstalling iQ-WORKLIST, the license must be reset and the uninstall confirmation code be emailed to your local reseller. Failure to do so may result in additional fees or having to reinstall iQ-WORKLIST to go through the reset process. To reset the license:

- Open a Command prompt in Windows
- Navigate to the iQ-WORKLIST installation folder. (By default, this is C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0 or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS).)
- Use the command "wlsrv.exe UNREGISTER" to reset the license. The following message will appear:



- After clicking "OK," an uninstall confirmation code will appear.



- Copy this code into an email (CTRL-C will work) addressed to the local reseller as proof of the license reset. Be sure to include the software name, version number, and the end user's information.
- Follow the instructions on the screen to click through the numbered buttons 1 – 3 before clicking "OK."

4.2 UNINSTALL THE SOFTWARE

Once the license has been reset, the software can be uninstalled from the computer. Administrator permissions are necessary to perform the uninstallation.

4.2.1 WINDOWS XP INSTRUCTIONS

- Open the "Control Panel" and select "Add or Remove Programs."
- Find iQ-WORKLIST in the list and select it.
- Click "Remove" to uninstall the software. Answer any prompts that appear during the uninstallation.

4.2.2 WINDOWS 7/SERVER 2008 INSTRUCTIONS

- Open the "Control Panel" and select "Uninstall a Program."
- Find iQ-WORKLIST in the list and select it.
- Click "Uninstall" just above the column headings to uninstall the software. Answer any prompts that appear during the uninstallation.

4.2.3 WINDOWS 8.1/WINDOWS 10/SERVER 2012/SERVER 2012R2/SERVER 2016 INSTRUCTIONS

- Open the "Control Panel" and select "Programs and Features".
- Find iQ-WORKLIST in the list and select it.
- Click "Uninstall" just above the column headings to uninstall the software. Answer any prompts that appear during the uninstallation.

5 LICENSING

5.1 LICENSE SYSTEM

iQ-WORKLIST comes with a 30 day trial license (starting from the day of installation) that allows its use with a limited set of features. During this time, iQ-WORKLIST can be used with 10 configured DICOM nodes, but it will not process any incoming HL7 ADT messages.

If the TRIAL license expires, or if you want a professional license, there are 3 editions of iQ-WORKLIST from which to choose:

- BASIC (2 DICOM nodes, no ADT)
- PRO (10 DICOM nodes, no ADT)
- PREMIUM (unlimited DICOM nodes, ADT supported)

5.2 ACTIVATING THE SOFTWARE

Before iQ-WORKLIST can be activated, the hardware fingerprint of the software must be sent to IMAGE Information Systems so a license key can be generated. This is typically done via your sales partner. To find the hardware fingerprint for iQ-WORKLIST, go through the following steps:

- Open a Command prompt in Windows
- Navigate to the iQ-WORKLIST installation folder. (By default, this is C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0\ or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS).)
- Use the command "wlsrv.exe REGISTER" to display the dialog that shows your current hardware fingerprint.

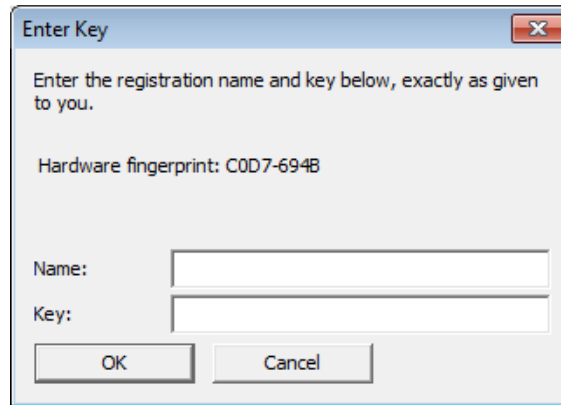
Send the fingerprint to your sales partner and they will return a Registration Name and License Key that should be used to activate the purchased edition of the application. (This will also contain any license customizations, if appropriate.)

NOTE:

Stop the Windows service "iQ-WORKLIST Service" before you activate a license. Otherwise, the license activation may have no effect.

To activate the application using the License Name and Key, use the following steps:

- Open a Command prompt in Windows
- Navigate to the iQ-WORKLIST installation folder. (By default, this is C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0 or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS).)
- Enter the command "wlsrv.exe REGISTER". Copy the respective license information provided by your sales partner into the dialog box that appears, and click "OK."



A screenshot of a Windows-style dialog box titled "Enter Key". The dialog has a standard title bar with a close button (X) in the top right corner. The main content area contains the following text: "Enter the registration name and key below, exactly as given to you." followed by "Hardware fingerprint: C0D7-694B". Below this, there are two input fields. The first is labeled "Name:" and the second is labeled "Key:". At the bottom of the dialog, there are two buttons: "OK" and "Cancel".

- If the registration is successful, a confirmation message will appear.

6 LICENSE MIGRATION

In order to migrate iQ-WORKLIST to another computer, the license must first be reset on the existing installation and the uninstall confirmation code emailed to the local reseller. Failure to do so may result in additional fees or having to reinstall iQ-WORKLIST to go through the reset process.

6.1 RESET THE LICENSE

See the instructions in chapter 4.1.

6.2 INSTALL IQ-WORKLIST ON THE NEW COMPUTER

See the instructions in chapter 3.1.

7 MAINTENANCE

7.1 MAINTENANCE MODE

iQ-WORKLIST is a broker that gets its data from an information system (e.g. HIS or RIS) and provides it to a modality or other DICOM nodes. Because of this, the application is not meant to store patient and study data over the long term.

The built-in Maintenance Mode helps the administrator keep the database clear of aged/outdated datasets and clears certain directories. The following data is deleted if it is outdated:

- Worklist jobs in the database (including patient data, if it is not related to other worklist jobs)
- Modality Performed Procedure Step information in the database
- Files in the following directories:

DESCRIPTION	PATH (RELATIVE TO CONFIGURATION.XML ATTRIBUTES)
Output directory for text files containing MPPS information	MPPSOutDir
"Done" folder for successfully imported general text files (not HL7 files)	inDir(General node)\done
"Error" folder for imperfectly imported general text files (not HL7 files)	inDir(General node)\error
Input directory of the HL7 facility	inDir(Facility node)
"Done" folder for successfully imported HL7 files	inDir(Facility node)\done
"Error" folder for imperfectly imported HL7 files	inDir(Facility node)\error
Output directory for file-based HL7 messages	outDir(Facility node)
Output directory for file-based "accept acknowledgement" messages	outDir(Facility node)*facility name*\accept acknowledgement
Output directory for file-based "application acknowledgement" messages	outDir(Facility node)*facility name*\application acknowledgement

iQ-WORKLIST checks during start-up and every 24 hours (default) for data that is older than 30 days (default). The configuration.xml file provides two attributes to change this default behavior. Both are attributes of the General node.

The first attribute, `maintenanceInterval`, is the number of hours between two maintenance jobs. Maintenance is performed when iQ-WORKLIST starts and from this moment forward every x hours. A `maintenanceInterval` value of 0 deactivates the maintenance feature entirely.

The other attribute, `maxDatasetAge`, is the number of days a dataset is kept by iQ-WORKLIST. Once a dataset exceeds this threshold, it gets deleted. The following properties are checked to evaluate the age of a dataset:

DATASET	PROPERTY USED TO EVALUATE THE AGE
Worklist job in database	Scheduled Procedure Step Start Date (0040,0002)
Modality Performed Procedure Step in database	Performed Procedure Step Start Date (0040,0244)
All text files in the file system	File creation date

7.2 APPLICATION LOGS

Six different log files are created by iQ-WORKLIST. Each contains information regarding one particular module. All log files are located in the log folder of the iQ-WORKLIST program data directory (%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\log). The following table outlines the content of each log file.

LOG FILE	DESCRIPTION OF CONTENT
data.log	<ul style="list-style-type: none"> Database transactions Executed SQL statements (DEBUG level) Processing status of order requests
dicom.log	<ul style="list-style-type: none"> DICOM message processing (e.g. worklist query, C-ECHO, MPPS N-CREATE, N-SET, and N-GET) (DEBUG level) Association negotiation (DEBUG level)
hl7.log	<ul style="list-style-type: none"> HL7 message processing (e.g. ORM, OGM, ADT) File-based HL7 message handling
hl7server.log	<ul style="list-style-type: none"> TCP/IP based message handling
mapping.log	<ul style="list-style-type: none"> Handling of general file-based messages (GDT, etc.) Message dump of incoming messages (DEBUG level) Information about dictionaries used (including HL7 messages) (TRACE level) Results of regular expressions (TRACE level) Information about code pages used (DEBUG level)
worklist.log	<ul style="list-style-type: none"> Version number and license information Information about watched input directories Details about maintenance (DEBUG level) Complete configuration dump (TRACE level)

To get more information about the log configuration, see chapter 9.1.6.

8 FOLDERS

iQ-WORKLIST files are stored in two separate directories. One is the installation directory which contains the executable file, and the other is the program data directory where logs, configuration, and other text files are written. The following tables list all files and directories used:

FILE	DESCRIPTION
Files within the installation directory (default: C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0 or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS))	
.\wlsrv.exe	Main application file
Files within the %AllUsersProfile% directory (default on Windows 7 and higher: C:\ProgramData\IMAGE Information Systems\iQ-WORKLIST\2.0)	
.\config\configuration.xml	General configuration file
.\config\dictionaries.xml	Dictionaries for mapping incoming and outgoing data
.\config\mapping.xml	Various mappings for incoming files
.\config\template.txt	Template file for file-based output of MPPS data
.\data\worklist.db	SQLite database file
.\log\data.log	Log file for database actions
.\log\dicom.log	Log file for DICOM message exchange
.\log\hl7.log	Log file for HL7 message processing
.\log\hl7server.log	Log file for HL7 message handling/exchange
.\log\mapping.log	Log file for mapping results
.\log\worklist.log	General log file

FOLDER	DESCRIPTION
C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0 or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS)	Installation directory
C:\ProgramData\IMAGE Information Systems\iQ-WORKLIST\2.0\	Program data directory of version 2.0
Folders within the %AllUsersProfile% directory (default on Windows 7 and higher: C:\ProgramData\IMAGE Information Systems\iQ-WORKLIST\2.0)	
.\config	Contains configuration files
.\data	Contains the SQLite database file
.\log	Location of the program's log files
.\exchange	Holds incoming and outgoing text messages
.\exchange\incoming\hl7	The directory where the program expects to receive HL7 files from the information system
.\exchange\incoming\hl7\done	Contains successfully processed HL7 file-based messages
.\exchange\incoming\hl7\error	Contains file-based HL7 messages that failed
.\exchange\incoming\text	The directory where the program expects to receive proprietary file-based messages from the information system
.\exchange\incoming\text\done	Contains successfully processed proprietary file-based messages
.\exchange\incoming\text\error	Contains file-based proprietary messages that failed
.\exchange\outgoing\hl7	Location of outgoing HL7 messages
.\exchange\outgoing\hl7\accept acknowledgement	Contains "accept response" messages to any incoming HL7 message
.\exchange\outgoing\hl7\application acknowledgement	Contains "application response" messages to any incoming HL7 message
.\exchange\outgoing\text	Contains information about received Modality Performed Procedure Steps

The input and output directories for HL7 and proprietary text files can be customized. See chapters 9.2.1.1 HL7 Message Files and 9.2.1.3 Proprietary Message Files for further information.

9 SOFTWARE ADMINISTRATION

9.1 CONFIGURATION

After iQ-WORKLIST is started the first time, a configuration file is created in “%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\config.” The file that contains the program parameters used during execution is “configuration.xml.”

If this file is present, but empty, iQ-WORKLIST will run using default values. Any settings specified in the configuration file are read and used during startup. For any settings not present, default values are assumed.

The configuration file has several nodes – one for each program module. The following chapters describe each node in detail.

NOTE:

All attributes listed below are case sensitive. A misspelled attribute will cause iQ-WORKLIST to fall back to the default value. Check the dumped configuration in the “worklist.log” file (TRACE level) to double-check the configuration used.

NOTE:

All changes made to “configuration.xml” require a restart of the iQ-WORKLIST service to take effect.

9.1.1 GENERAL

The `General` node of the configuration file contains settings for the automatic maintenance of iQ-WORKLIST as well as folders used for reading worklist jobs. The following attributes may be customized:

NAME	TYPE	DEFAULT	PURPOSE
inDir	string	“%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\Exchange\Text\Incoming”	Specifies the folder to monitor for incoming file-based messages
maintenanceInterval	positive integer	24	Defines the maintenance interval in hours. 0 turns this feature off.
maxDatasetAge	positive integer	30	Defines the maximum age (in days) of stored datasets in iQ-WORKLIST

9.1.2 DICOM

The `DICOM` node of the configuration file contains settings specific to DICOM connections, the `AETitle` and `port` of iQ-WORKLIST, MPPS settings, and other options.

NAME	TYPE	DEFAULT	PURPOSE
AETitle	string	IQWL	The DICOM AETitle of iQ-WORKLIST
port	positive integer	104	The local port on which iQ-WORKLIST listens
maxAssociations	positive integer	25	Maximum concurrent DICOM associations
maxConnectionsPerAETitle	positive integer	25	Maximum connections that each DICOM node can establish to iQ-WORKLIST
maxPDU	positive integer	16384	Maximum network package size iQ-WORKLIST can receive
writeMPPSChangesToFile	boolean	0	0 = false, 1 = true; if true, instructs iQ-WORKLIST to use the <code>template.txt</code> file to generate MPPS status change messages in <code>MPPSOutDir</code> .
MPPSOutDir	string	"%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\Exchange\Outgoing\text"	Specifies the folder where MPPS data is written
disableGethostbyaddr	Boolean	1	0 = false, 1 = true; if true then the global reverse DNS lookup is disabled on accepting associations.
DIMSETimeout	positive integer	0	Timeout for DIMSE operations (e.g. C-FIND requests) in seconds. 0 = unlimited.
ACSETimeout	positive integer	30	Timeout for ACSE operations (association negotiation) in seconds.
accNoPrefix	string	[empty]	Prefix for accession numbers generated by iQ-WORKLIST. Maximum size is 7 bytes. (Alphanumeric ASCII characters recommended)
accNoSuffixType	specific value	TIMESTAMP	[TIMESTAMP, INCREMENTEDID] The suffix is put behind the <code>accNoPrefix</code> . Value can either be the current datetime (TIMESTAMP) or an automatically incremented number padded with 0s (INCREMENTEDID).

NAME	TYPE	DEFAULT	PURPOSE
accNoID	positive integer	0	The current number of the accession number suffix if accNoSuffixType is set to INCREMENTEDID.

9.1.2.1 DICOM ENTITIES

Inside the `DICOM` XML node, DICOM entities that need to connect to iQ-WORKLIST can be configured. These are defined in the `Entities` node, and each modality, viewer, or PACS must be identified in one `Entity` node.

There are no assumptions or defaults for DICOM entities. Each must be defined individually for every connecting DICOM node. A valid DICOM entity must have a value for the attributes `name` and `AETitle`. The attribute `characterSet` is optional.

NAME	TYPE	DEFAULT	PURPOSE
name	string	[none]	Descriptive name of the DICOM node
AETitle	string	[none]	Application Entity title of the DICOM node. This name must match the "Calling AETitle" of the incoming DICOM requests.
characterSet	String	[none]	Return worklist responses with the provided specific character set. Must be a "Defined Term" defined in the DICOM standard part 3 in chapter C.12.1.1.2 Specific Character Set. E.g. "ISO_IR 100" to force a Latin1 encoding

9.1.3 HL7

The `HL7` node of the configuration file contains settings specific to HL7 connections, the local HL7 endpoint, and HL7 listening port of iQ-WORKLIST.

NAME	TYPE	DEFAULT	PURPOSE
port	positive integer	2100	The local HL7 port on which iQ-WORKLIST listens
timeout	positive integer	30	Time in seconds that iQ-WORKLIST waits during shutdown to process messages still in the queue
facilityName	string	IQWL	Name of the facility where iQ-WORKLIST is installed or running
applicationName	string	IQWLHL7	The name of iQ-WORKLIST for HL7 communication

9.1.3.1 FACILITIES

The **Facilities** node resides under the HL7 node and specifies local communication endpoints for HL7 communication.

NOTE:

This version of iQ-WORKLIST supports only one facility.

If **name**, **appName**, **inDir**, **outDir**, **hostname**, or **port** values are missing, the facility is ignored.

NAME	TYPE	DEFAULT	PURPOSE
name	string	Default name	Name of the connected facility (e.g. "RAD")
appName	string	Default application name	Name of the connected application
type	specific value	TCPIP	[TCPIP, FILE] The facility can either send/receive HL7 message via the network (TCPIP) or via a file system (FILE).
inDir	string	"%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\Exchange\Incoming\HL7"	This is the watched directory for incoming file-based HL7 communication (type = FILE)
outDir	string	"%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\Exchange\Outgoing\HL7"	This is the directory for all outgoing messages created by iQ-WORKLIST (type = FILE)
host	IPv4 address	127.0.0.1	IP address of the connected HL7 system for response messages (type = TCPIP)
port	positive integer	2100	Port of the connected HL7 system for response messages (type = TCPIP)
acceptAckType	specific value	ALWAYS	[ALWAYS, ERROR_REJECTED, NEVER, SUCCESS, UNKNOWN] Value for sending "accept acknowledgment" message back to sending system.
applicationAckType	specific value	ALWAYS	[ALWAYS, ERROR_REJECTED, NEVER, SUCCESS, UNKNOWN] Value for sending "application acknowledgment" message back to sending system.

NAME	TYPE	DEFAULT	PURPOSE
MPPSNotification	specific value	NO	[YES, NO, COMPLETED_DISCONTINUED] iQ-WORKLIST notifies the facility about all changes (YES) or only status changes (COMPLETED_DISCONTINUED) of the performed procedure.

NOTE:

The default values are only used if no facility is specified. This is necessary to enable basic communication.

9.1.4 DATASOURCE

Currently, iQ-WORKLIST only supports working with SQLITE. Thus, every value besides database type is ignored.

NAME	TYPE	DEFAULT	PURPOSE
hostname	string/Ipv4 address	Default hostname	Hostname/IP where the database resides
databaseName	string	Default database	The name of the database to use
username	string	Default user	Username to connect to the database
password	string	Default password	Password for the provided user
port	positive integer	0	Port on which the database listens
databaseType	specific value	SQLITE	[SQLITE] Type of DBMS used. Currently, only SQLITE is supported.

9.1.5 MAPPING

The Mapping node contains attributes to configure text-based (HL7 and general text files) and network based communication.

NAME	TYPE	DEFAULT	PURPOSE
mappingID	positive integer	[empty]	Preset mapping for incoming general text files. (Mapping for HL7 messages is based on the MSH segment of the message)
codePage	positive integer	0	Preset Windows code page used to encode incoming order messages to UTF-8. 0 is the default system code page. This value is overridden by the code page defined within the current mapping definition.
timeOut	positive integer	500	Timeout for file reading operations in milliseconds

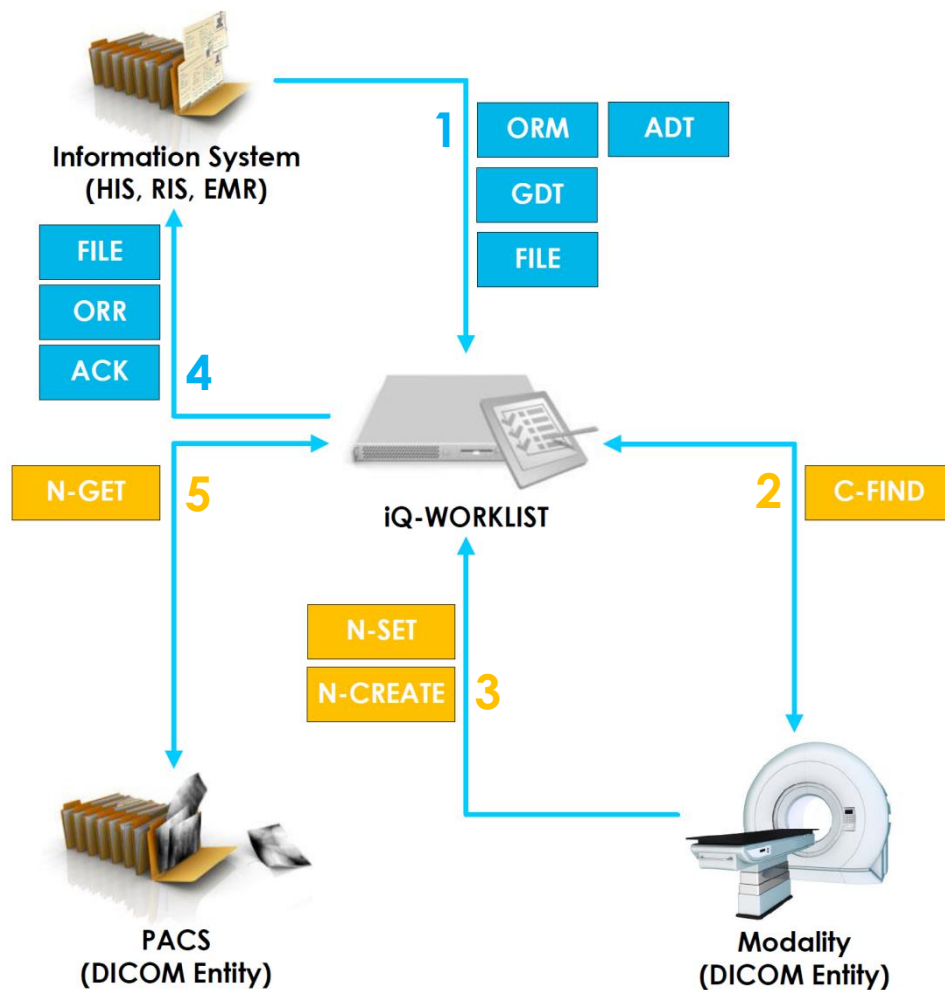
9.1.6 LOGGING

There is a nested `Logging` node for each of the above defined nodes. It can be safely omitted to use the default log settings. For each of the above nodes, a corresponding log file can be found in “%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\log” that contains the respective log output. Log levels may be adjusted separately for each component of iQ-WORKLIST.

NAME	TYPE	DEFAULT	PURPOSE
maxFileSize	positive integer	10485760	Size in bytes to which a single log file may grow. A new log file is created when the limit is exceeded. Example: 10485760 bytes =10 megabytes
maxFileCount	positive integer	1	Defines the maximum number of backup log files that iQ-WORKLIST will create
logMode	specific value	ROLLING	[ROLLING, DAILY] Daily logs write one log file per day. Rolling logs create a new file only if <code>maxFileSize</code> is exceeded.
logLevel	specific value	INFO	[TRACE, DEBUG, INFO, WARNING, ERROR, FATAL, OFF] TRACE and DEBUG levels print information about the program internals to the log file such as patient data, connection data, etc. This can be useful if support is required. During normal productive use, INFO is sufficient as it will also print hints, warnings, or fatal messages.

9.2 WORKFLOW

The following picture describes the common workflow of iQ-WORKLIST.



1. iQ-WORKLIST receives worklist jobs via TCP/IP or file-based communication. It is able to process HL7, GDT, and proprietary formats.
2. The modality queries iQ-WORKLIST for scheduled worklist jobs.
3. The modality sends information about the performed study (MPPS) back to iQ-WORKLIST.
4. iQ-WORKLIST processes the MPPS information and informs the connected information system about the current state of the performed study using HL7 or a proprietary message format.
5. Connected DICOM entities can query information about a performed study.

9.2.1 CREATING THE WORKLIST ITEM/JOB

After sending an order request to iQ-WORKLIST, the data.log file shows whether the order was processed or not.

To create a valid worklist job, it is important that the required information is provided. The table below lists all required information as well as some additional recommended, but optional, information useful for increasing the quality of the worklist job.

ATTRIBUTE	TAG	VALUE
(0010,0010)	Patient's Name	USER
(0010,0020)	Patient ID	USER
(0010,0030)	Patient's Date of Birth	RECOMMENDED
(0010,0040)	Patient's Sex	RECOMMENDED
(0008,0090)	Referring Physician's Name	RECOMMENDED
(0008,0050)	Accession Number	AUTO
(0040,1001)	Requested Procedure ID	AUTO
(0032,1060)	Requested Procedure Description	USER ¹
(0032,1064) Requested Procedure Code Sequence		
(0008,0100)	Code Value	USER ¹
(0008,0102)	Coding Scheme Designator	USER ¹
(0020,000D)	Study Instance UID	AUTO
(0040,0100) Scheduled Procedure Step		
(0040,0009)	Scheduled Procedure Step ID	AUTO
(0040,0001)	Scheduled Station AE Title	USER
(0008,0060)	Modality	USER
(0040,0002)	Scheduled Procedure Step Start Date	AUTO
(0040,0003)	Scheduled Procedure Step Start Time	AUTO
(0040,0007)	Scheduled Procedure Step Description	USER ²
(0040,0100)>(0040,0008) Scheduled Protocol Code Sequence		
(0008,0100)	Code Value	USER ²
(0008,0130)	Coding Scheme Designator	USER ²

USER The information system must provide a value for this attribute.

AUTO The information system can provide a value for this attribute. If there is no value, iQ-WORKLIST will create one automatically.

RECOMMENDED It is recommended that the information system provides a value for this attribute.

¹ Either the Requested Procedure Description or both fields of the Requested Procedure Code Sequence must be provided

² Either the Scheduled Procedure Step Description or both fields of the Scheduled Protocol Code Sequence must be provided

The automatically created start date, start time, and IDs (Requested Procedure ID, Scheduled Procedure Step ID) are based on the current system time of the computer where iQ-WORKLIST is installed. Both IDs are timestamps of the format YYMMDDhhmmssccc (c stands for milliseconds).

Study Instance UIDs are based on the application's root UID, which is 1.2.826.0.1.3680043.2.360.34.

Accession numbers are often used by information systems as identifiers for a studies. This identifier can be configured in iQ-WORKLIST using two attributes in the configuration.xml file, `accNoSuffixType` and `accNoPrefix`.

```
<DICOM accNoSuffixType="TIMESTAMP" accNoPrefix="">
```

The value set in `accNoPrefix` is the static text written to the beginning of all accession numbers. The text can be up to 7 bytes long and the recommendation is that it contain only alphanumeric characters. The parameter `accNoSuffixType` is used to define the dynamic part of the accession number. The following table shows some sample configurations:

CONFIGURATION	NEW ACCESSION NUMBER
<code>accNoSuffixType="TIMESTAMP"</code> <code>accNoPrefix=""</code>	131130095523887
<code>accNoSuffixType="TIMESTAMP"</code> <code>accNoPrefix="IMAGE_"</code>	IMAGE_095523887
<code>accNoSuffixType="INCREMENTEDID"</code> <code>accNoPrefix=""</code>	1000000123
<code>accNoSuffixType="INCREMENTEDID"</code> <code>accNoPrefix="IMAGE_"</code>	IMAGE_000000123

Any `accNoPrefix` that exceeds the maximum length of 7 bytes is not used. Instead, this attribute is handled as if it is empty.

9.2.1.1 HL7 MESSAGE FILES

iQ-WORKLIST is able to retrieve HL7 messages from a folder. The incoming folder is configured for the connected facility in the configuration.xml file of iQ-WORKLIST. For this version of iQ-WORKLIST, only one facility can be created. The facility has its own XML node and the configuration is set by changing the attributes of this node.

The most important attributes for feeding iQ-WORKLIST with HL7 files are the following:

ATTRIBUTE	DESCRIPTION
type	This attribute defines the communication type of iQ-WORKLIST and can have two values "TCP/IP" and "FILE". To process HL7 files from a folder change the value to "FILE".
inDir	This attribute defines the directory to be watched by iQ-WORKLIST. The value should be the incoming directory where the HL7 files will be put to be processed. (Example: "C:\ProgramData\IMAGE Information Systems\iQ-WORKLIST\2.0\exchange\incoming\hl7").
outDir	This attribute defines the location where the response HL7 files generated by iQ-WORKLIST are stored. (Example: "C:\ProgramData\IMAGE Information Systems\iQ-WORKLIST\2.0\exchange\outgoing\hl7"). This outgoing directory has its own structure and is based on the facility name and the type of response message.

All incoming HL7 messages are recognized if these three attributes are configured correctly. After an incoming file has been processed successfully, it is moved to a subfolder called "done." If the incoming message fails, it is moved to a subfolder called "error." These subfolders help keep the configured inDir clean.

NOTE:

The directories used may be local directories shared on the network or drives in the network accessed through a UNC path. Mapped drives, on the other hand, are not supported!

Attribute: acceptAckType

If the connected information system does not use the MSH-15 (Accept Acknowledgment Type) in an incoming HL7 message, this attribute is taken into account. It contains the conditions under which accept acknowledgement messages are required to be returned in response to the incoming message. The attribute can have following values:

ALWAYS	An accept acknowledgment (ACK) is returned for all cases
ERROR_REJECTED	An accept acknowledgement (ACK) is returned only if the message was not accepted
NEVER	No accept acknowledgement (ACK) is returned
SUCCESS	An accept acknowledgement (ACK) is returned only if the message was accepted

Attribute: applicationAckType

If the connected information system does not use the MSH-16 (Application Acknowledgment Type) in an incoming HL7 message, this attribute is taken into account. It contains the conditions under which application acknowledgement messages are required to be returned in response to the incoming message. The attribute can have following values:

ALWAYS	An application acknowledgment (ORR/ORG) is returned for all cases
ERROR_REJECTED	An application acknowledgement (ORR/ORG) is returned only if the message cannot be processed
NEVER	No application acknowledgment (ORR/ORG) is returned
SUCCESS	An application acknowledgement (ORR/ORG) is returned only if the message was processed successfully

Attribute: MPPSNotification

iQ-WORKLIST is able to send an event notification back to the information system. This notification includes the status update of a performed procedure that has been scheduled by the information system. Possible status values can be "IN PROGRESS", "DISCONTINUED", or "COMPLETED." The attribute contains the conditions under which event notifications are required to be sent. The attribute can have following values:

YES	Always sends an event notification message
NO	Never sends an event notification message
DISCONTINUED_COMPLETED	Sends an event notification when the performed procedure has reached its final status ("COMPLETED" or "DISCONTINUED")

For more information about incoming and outgoing HL7 messages please refer to the iQ-WORKLIST HL7 Conformance Statement.

9.2.1.2 HL7 VIA NETWORK

iQ-WORKLIST is able to retrieve and send HL7 messages via TCP/IP communication. The HL7 server starts when iQ-WORKLIST is initiated. It is configured in the configuration.xml file. The attributes of the XML node `HL7` is used to change the HL7 server configuration. The following attributes may be altered:

ATTRIBUTE	DESCRIPTION
port	Listening port of the iQ-WORKLIST HL7 server
facilityName	The name of the facility where iQ-WORKLIST is installed and is part of an incoming HL7 message (MSH-5 Receiving Facility)
applicationName	The application name of iQ-WORKLIST in the installed environment (e.g. iQWKL) and is configured as part of an incoming HL7 message (MSH-4 Receiving Application)

After the HL7 server is configured, it is important to also set up the connected HL7 facility. Within the `HL7` XML node is a sub node called `Facility`. If this XML node is not configured correctly, all incoming HL7 messages will be rejected by iQ-WORKLIST. Therefore, it is important that the following attributes of the `Facility` node be closely examined:

ATTRIBUTE	DESCRIPTION
name	Name of the connected information system/facility (e.g. HIS). It is part of an incoming HL7 message (MSH-3 Sending Facility).
appName	Name of the connected information system/software (e.g. hl7server). It is part of an incoming HL7 message (MSH-2 Sending Application).
type	Defines the communication type of iQ-WORKLIST and can have two values "TCPIP" and "FILE". To process HL7 messages via TCP/IP, change the value to "TCPIP".
host	The IP address or host name of the connected information system. It is used to transmit the outgoing HL7 response messages (ORR/ORG) to the information system.
port	Port of the connected information system where outgoing HL7 response messages (ORR/ORG) are sent.

Incoming HL7 messages are accepted if these attributes are configured correctly. Upon receiving an HL7 message, iQ-WORKLIST returns two separate response messages. The first is the accept acknowledgement (ACK) and informs the sender about a successfully received message. This response message is sent back within the same connection. The other response is an application acknowledgement (ORR/ORG) and informs the sender about the status after processing the incoming HL7 message. It is sent over a separate connection to the configured `host` and `port`. This workflow can be configured by the following attributes of the `Facility` XML node:

Attribute: `acceptAckType`

If the connected information system does not use the MSH-15 (Accept Acknowledgment Type) in an incoming HL7 message, this attribute is taken into account. It contains the conditions under which accept acknowledgement messages are required to be returned in response to the incoming message. The attribute can have following values:

ALWAYS	An accept acknowledgment (ACK) is returned for all cases
ERROR_REJECTED	An accept acknowledgement (ACK) is returned only if the message was not accepted
NEVER	No accept acknowledgement (ACK) is returned
SUCCESS	An accept acknowledgement (ACK) is returned only if the message was accepted

Attribute: `applicationAckType`

If the connected information system does not use the MSH-16 (Application Acknowledgment Type) in an incoming HL7 message, this attribute is taken into account. It contains the conditions under which application acknowledgement messages are required to be returned in response to the incoming message. The attribute can have following values:

ALWAYS	An application acknowledgment (ORR/ORG) is returned for all cases
ERROR_REJECTED	An application acknowledgement (ORR/ORG) is returned only if the message cannot be processed
NEVER	No application acknowledgement (ORR/ORG) is returned
SUCCESS	An application acknowledgement (ORR/ORG) is returned only if the message was processed successfully

Attribute: MPPSNotification

iQ-WORKLIST is able to send an event notification back to the information system. This notification includes the status update of a performed procedure that has been scheduled by the information system. Possible status values can be "IN PROGRESS", "DISCONTINUED", or "COMPLETED." The attribute contains the conditions under which event notifications are required to be sent. The attribute can have following values:

YES	Always sends an event notification message
NO	Never sends an event notification message
DISCONTINUED_COMPLETED	Sends an event notification when the performed procedure has reached its final status ("COMPLETED" or "DISCONTINUED")

For more information about incoming and outgoing HL7 messages, please refer to the iQ-WORKLIST HL7 Conformance Statement.

9.2.1.3 PROPRIETARY MESSAGE FILES

iQ-WORKLIST is able to retrieve general, file-based messages from a folder. The incoming folder is configured in the attribute `inDir` of the `general` node in the `configuration.xml` file of iQ-WORKLIST. All message files dropped in this folder are handled by a mapping file as described in chapter 9.3.2 Mapping of Proprietary Message Formats. After an incoming file has been processed successfully, it is moved to a subfolder of `inDir` named "done." If the incoming message is unsuccessful, it is moved to the "error" subfolder instead. These subfolders help keep the `inDir` folder clean of messages that have been handled.

If the iQ-WORKLIST service is started and the `inDir` folder already contains message files, then all message files will be handled immediately.

NOTE:

The directories used may be local directories shared on the network or drives in the network accessed through a UNC path. Mapped drives, on the other hand, are not supported!

9.2.2 DICOM COMMUNICATION

Modalities and other DICOM nodes can query iQ-WORKLIST to get a list of scheduled procedures (worklist jobs). Procedures may be scheduled using text files or HL7 messages. See chapter 9.2.1 for more information.

iQ-WORKLIST's DICOM server starts with the application and listens on port 104. Its default Application Entity Title (AET) is IQWL. This configuration can be changed in the configuration.xml file. The XML node `DICOM` contains the following attributes.

ATTRIBUTE	DESCRIPTION
port	Port of the DICOM server
AETitle	Application Entity Title (the alias) of iQ-WORKLIST in the DICOM network

The iQ-WORKLIST service must be restarted after changing this configuration.

DICOM communication with iQ-WORKLIST is restrictive. iQ-WORKLIST must know the requesting station (AETitle) or it will refuse the association request with a "bad sender AE" error. Requesting stations (DICOM entities) must be configured in the configuration.xml file. The XML node `DICOM` has a sub node called `Entities` which, in turn, should have one sub node per requesting station called `Entity`. The `Entity` node has the following attributes:

ATTRIBUTE	DESCRIPTION
name	Description of the requesting station
AETitle	Application Entity Title of the requesting station. This value must match the "Calling AET" field of an incoming association request. Otherwise, the request will be rejected.

Detailed information about the supported SOP classes and their DICOM attributes can be found in the DICOM Conformance Statement of iQ-WORKLIST.

9.2.2.1 VERIFYING THE CONNECTION

By sending a C-ECHO to iQ-WORKLIST, the availability of the DICOM server can be verified. If the C-ECHO message fails, it is recommended that you double-check the firewall exception list to see if the executable file of iQ-WORKLIST has been added. Furthermore, the requesting application must be registered as a DICOM node in the configuration.xml file. See chapter 9.2.2 for further information about the configuration of the DICOM server.

9.2.2.2 QUERYING THE WORKLIST

A worklist query (C-FIND) returns a list of scheduled procedures. The complexity of the resulting list can be reduced by setting values for certain attributes that act as filters. The DICOM attributes supported as filters, or just simple return keys, can be found in the iQ-WORKLIST DICOM Conformance Statement.

9.2.2.3 CREATING AND UPDATING MPPS

If supported, modalities can send MPPS (Modality Performed Procedure Steps) messages (N-CREATE, N-SET) to convey details regarding procedures performed back to iQ-WORKLIST. Below are the most important pieces of information conveyed:

- Status of the performed procedure
- End date and time of the procedure
- Performed series information
- Radiation dose
- Billing data
- Exposure dose
- Film consumption

Performed procedures have one of the following relations to a scheduled procedure (worklist job):

- 0-to-1 (unscheduled case)
- 1-to-1 (scheduled case)
- 1-to-n (appended case)
- n-to-1 (group case)
- n-to-m (append to group case)

The supported DICOM attributes can be found in the iQ-WORKLIST DICOM Conformance Statement.

9.2.3 SENDING UPDATES TO THE INFORMATION SYSTEM

iQ-WORKLIST is able to inform the connected information systems about performed procedures. The condition for using this feature is that the connected modalities must support MPPS and have the ability to send feedback about the procedure to iQ-WORKLIST. iQ-WORKLIST processes the following MPPS status changes:

STATUS	DESCRIPTION
→ IN PROGRESS	The status is set to "IN PROGRESS" when the procedure is started. There can be multiple MPPS updates that trigger one notification message each. Once the procedure is performed, the status is changed to "COMPLETED" or "DISCONTINUED."
IN PROGRESS → COMPLETED	The status changes from "IN PROGRESS" to "COMPLETED" if the procedure has been performed.
IN PROGRESS → DISCONTINUED	The status changes from "IN PROGRESS" to "DISCONTINUED" if the procedure has been canceled.

9.2.3.1 HL7 VIA NETWORK

iQ-WORKLIST can transmit MPPS status changes via the network to the connected information system. This is part of the HL7 acknowledgement and is called "event notification." It is an unsolicited communication with the information system. When an ORM^O01 message is received, iQ-WORKLIST will respond with an ORR^O02 message. For OMG^O19 messages, iQ-WORKLIST responds with an ORG^O20 message.

The outgoing HL7 message contains multiple identifiers to classify the message as an event notification and detect the procedure status:

HL7-FIELD	VALUE	INFORMATION
MSA-1	CA	Commit Accept
ORC-1	SC	Status Changed = event notification
ORC-5	IP	IN PROGRESS
	CM	COMPLETED
	DC	DISCONTINUED

Not all information systems support event notification messages. That is why there are options to configure this feature in the configuration.xml file of iQ-WORKLIST. The attribute `MPPSNotification` resides in the `Facility` node and can contain one of the following values:

YES	Always sends an event notification message
NO	Never sends an event notification message
DISCONTINUED_COMPLETED	Sends an event notification when the performed procedure has reached its final status ("COMPLETED" or "DISCONTINUED")

9.2.3.2 HL7 MESSAGE FILE

HL7 message file communication is very similar to communicating via a network. The status values used and the generation of HL7 messages are the same. It also uses the same mapping and configuration. The only difference is that file-based communication works with a folder to exchange information.

The `Facility` node within the configuration.xml file can be used to configure the output directory.

ATTRIBUTE	DESCRIPTION
outDir	Outgoing directory where iQ-WORKLIST stores file-based messages to be read by the information system

The event notification messages (ORR^O02, ORG^O20) are put into the "application acknowledgement" subfolder within the `outDir` folder.

9.2.3.3 PROPRIETARY MESSAGE FILE

A subset of an MPPS entry can be written to a text file. The file created is based on the "template.txt" file located in the "config" folder of the iQ-WORKLIST program data directory. The new file is dropped into the `MPPSOutDir` configured in the configuration.xml file (DICOM node).

This feature is deactivated by default. To activate it, the attribute value of `writeMPPSChangesToFile` must be changed to 1. This is also an attribute of the DICOM node.

The template.txt file can be adapted to arrange data in an expected format. Placeholders are used to put information about the performed study into certain positions. The table below lists all placeholders:

PLACEHOLDER	DESCRIPTION
Generally valid placeholders	
@performedStudyUid	Study instance uid of the performed study
@performedStationAet	Station AE title of the modality on which the study was performed
@performedStationName	Name of the modality on which the study was performed
@performedStartDate	Date on which the study started
@performedStartTime	Time at which the study started
@performedEndDate	Date on which the study ended
@performedEndTime	Time at which the study ended
@status	Current status of the study. Defined values are: IN PROGRESS, COMPLETED, DISCONTINUED
@performedProcedureStepId	Identifier of the performed study
@performedProcedureStepDescription	Description or classification of the procedure that was performed
@performedProcedureStepComments	Comment regarding the performed study
@performedSopInstanceUid	Unique identifier of the Modality Performed Procedure Step
@performedModality	Type of equipment where the study was performed
@scheduled_procedure_steps[...]	This placeholder is used to group information regarding the scheduled study. One performed study can be based on several scheduled studies and is why this information must be grouped. The placeholders grouped within this placeholder are not available outside [[and]]. All text within the double square brackets is repeated for each scheduled study related to the performed study.
Only valid within @scheduled_procedure_steps[[...]]	
@scheduledStationAet	Station AE title of the modality on which the study was scheduled
@scheduledStartDate	Date on which the study was scheduled
@scheduledStartTime	Time at which the study was scheduled
@scheduledModality	Type of equipment where the study was scheduled
@performingPhysician	Name of the performing physician
@scheduledProcedureStepDescription	Description or classification of the scheduled study

PLACEHOLDER	DESCRIPTION
@scheduledStationName	Name of the modality on which the study was scheduled
@scheduledLocation	Description of the location where the study was scheduled
@scheduledProcedureStepId	Identifier of the scheduled study

9.3 MAPPING

Mapping for incoming files is configured in the mapping.xml file within the program data folder (%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0\config). It contains one mapping (XML node `Mapping`) for each file type (structured format such as HL7 or GDT). The screenshot below provides an overview about the mapping.xml file:

```

1      <?xml version="1.0" encoding="UTF-8"?>
2      <MappingConfiguration>
3      <Mapping ID="GDT mapping version 1.0">
306
307      <Mapping ID="ORM^001">
539
540      <Mapping ID="OMG^019">
772
773      <Mapping ID="ADT^A08">
853
854      <Mapping ID="ADT^A40">
882
883      <Mapping ID="ACK">
910
911      <Mapping ID="ORR^002">
1149
1150      <Mapping ID="ORG^020">
1388
1389      </MappingConfiguration>
1390

```

Each `Mapping` node contains a specific configuration for a certain file type. The attribute `ID` uniquely identifies a mapping in the mapping.xml file.

Within each `Mapping` node several XML nodes define the characteristics of the mapping. The most important XML node is `Data`. It contains the mapping between DICOM attributes and specifics of the file type. The structure of the sub nodes of `Data` is based on the supported subset of the Modality Worklist Information Model.

The `CodePage` node is used to define a default Windows code page (the "identifier" in the table provided by MSDN). If the respective mapping is used to map an incoming file format, this code page is used to interpret the content of the message and translate it correctly to a more universal code page (UTF-8). The default value (0) means that the current code page is used (see worklist.log TRACE level). If the local code page differs from the code page of the computer that sends the orders, this attribute must be set to the code page of the sending computer (a value usually around 1252).

The XML nodes within the `Mapping` node are used in a slightly different way depending on the file type to be mapped. There is a difference between the mapping of HL7-based formats and other proprietary

formats (e.g. GDT). To clarify these differences, both mappings are described in details within the following two chapters.

9.3.1 MAPPING OF HL7 MESSAGES

iQ-WORKLIST uses this mapping to parse and create every incoming or outgoing HL7 message. It is used for file-based as well as network communication. The mapping of HL7 messages is handled by an XML file called "mapping.xml." A general description of the mapping can be found above in chapter 9.3.

The mapping of an HL7 message is based on the HL7 field Message Type (MSH-9). iQ-WORKLIST uses this value to identify the correct mapping by comparing it with the `ID` attribute.

Once the mapping is identified, the following XML nodes (sub nodes of the `Mapping` node) are used to configure and adapt the processes:

XML NODE	DESCRIPTION
Format	Describes the way of interpreting the data mapping (see <code>Data</code> node). If the value is HL7 (recommended), HL7 field addressing (e.g. OBR-12) can be used to do the mapping.
FileExtensions	Contains one or more <code>FileExtension</code> nodes describing the supported file extensions typically used for this mapping. For file-based HL7 communication, all incoming HL7 files with one of these extensions are processed by iQ-WORKLIST.
Data	<p>Includes multiple XML nodes and is responsible for the actual data mapping. All supported DICOM tags are listed under this node. Each DICOM tag can be mapped to one or more values from the HL7 message and vice versa. See below for an example of an inbound HL7 mapping:</p> <pre> <!-- (0010,0020) Patient ID [Patient Identification] --> <!-- required --> <DCMTag group="0010" element="0020" dictionary="" default="">PID-3 PID-: </pre> <p>Above the XML node is a comment that explains the meaning of the node. Each <code>DCMTag</code> XML node represents one DICOM attribute. The attributes <code>group</code> and <code>element</code> define the tag of the DICOM attribute. The value of the <code>DCMTag</code> node is the value to be inserted. The attribute <code>dictionary</code> can be filled with the name of a defined dictionary in the <code>dictionary.xml</code> file. This is important for incoming/outgoing values which need to be translated to/from DICOM (e.g. Patient's Sex). Please refer to chapter 9.4 for more information about the <code>dictionary.xml</code> file.</p> <p>The value of the DICOM attribute is retrieved by using the HL7 field addressing syntax (e.g. "PID-3 PID-2"). These codes describe the respective HL7 field/component/subcomponent from where iQ-WORKLIST reads the value. The syntax looks like this:</p> <ul style="list-style-type: none"> ▪ SEGMENT-Field.Component.Subcomponent <ul style="list-style-type: none"> ○ E.g. PID-11.1.1

XML NODE	DESCRIPTION
	<p>The pipe (), as used in the example above, is used to provide alternative values. In the example, iQ-WORKLIST tries to get the Patient ID from PID-3. If this field is empty, it will read PID-2.</p> <p>If the configured HL7 field does not provide a value, the value of the attribute <code>default</code>, if configured, is used as the default value. This attribute works for incoming and outgoing messages.</p>
Actions	<p>This XML node is designed to set the action performed by iQ-WORKLIST. An incoming HL7 message creates, updates, or cancels a worklist job. The identifier that triggers these actions is conveyed in each HL7 message.</p> <pre> <Actions ID="event request"> <!-- required --> <Trigger>ORC-1</Trigger> <ExpectedValues> <Value action="new">NW</Value> <Value action="delete">CA</Value> <Value action="modify">XO</Value> </ExpectedValues> </Actions> </pre> <p>The <code>Trigger</code> sub node is the HL7 field where iQ-WORKLIST finds the value to determine the required action. In this example, it is the ORC-1 (Order Control) field that decides what action to take. If the value in ORC-1 is "NW" a new worklist job is created. If it is "CA," an existing worklist job is deleted. A value of "XO" will cause an existing worklist job to be modified.</p> <p>For outgoing HL7 messages, there are multiple <code>actions</code> nodes defined due to several status permutations. This is why each <code>actions</code> node has its own <code>ID</code>. This is to identify the correct <code>actions</code> node for the message. There is always a <code>Trigger</code> node that relates to the HL7 field where the corresponding information can be found.</p>

iQ-WORKLIST is deployed with a `mapping.xml` file that includes configurations for all message types listed in the HL7 Conformance Statement. If an incoming message is rejected by iQ-WORKLIST, it is likely related to missing information in the incoming HL7 message. See chapter 9.2.1 for a complete list of required attributes.

NOTE:

iQ-WORKLIST only supports the HL7 message types described above. For more information, refer to the iQ-WORKLIST HL7 Conformance Statement. Furthermore, it is not possible to add other DCMTags, actions, or expected values in this version of iQ-WORKLIST.

9.3.2 MAPPING OF PROPRIETARY MESSAGE FORMATS

iQ-WORKLIST uses mapping of proprietary message formats to parse general file-based messages received in the `inDir` folder (see chapter 9.2.1.3 Proprietary Message Files).

To designate a mapping to be used on non-HL7 file-based messages, the mapping type must be defined:

```
<MappingType>RegexPCRE</MappingType>
```

The current version of iQ-WORKLIST supports the mapping type "RegexPCRE" only, which translates to "Regular expressions in PCRE syntax" (PCRE = Perl Compatible Regular Expressions).

The mapping process is handled in the following way:

1. Find the right mapping.
2. Split incoming message into sub-messages.
3. Map message content into DICOM worklist job data.
4. Insert/Update/Delete the worklist job.

The following paragraphs explain the details.

Find the right mapping:

If iQ-WORKLIST receives a file-based message, it first tries to find the mapping which best fits the message. The mapping can be preset within the configuration.xml file only if one mapping is used for all incoming message files. If no mapping is preset, then iQ-WORKLIST will compare the file extension of the incoming message file with all mappings in the order they are defined in mapping.xml. The first mapping it matches will be used. If no mapping is matched then iQ-WORKLIST will check the content of the incoming message against the values for `ContentIdentifier` in the order defined in mapping.xml. Again, the first mapping that matches will be used. If still no mapping fits, then no mapping is done and the message is rejected.

Every `Mapping` node defined in mapping.xml is represented by a unique identifier attribute `ID`. To preset a mapping, this `ID` value must be set as a `mappingID` attribute in the `Mapping` node in the configuration.xml file. If a matching `mappingID` is found, no further searching for mappings is done on incoming message files.

A mapping can be linked with one or more file extensions of incoming message files. These links are defined by `Extension` nodes within the `FileExtensions` node of the mapping. If no file extension is linked with a mapping, then no searching of mapping is done by the file extension. A file extension can be linked with more than one mapping. However, the first mapping it finds for the file extension of the incoming message will be used.

Placeholders and wildcards such as '?' or '*' are not supported in this version of iQ-WORKLIST. An empty `Extension` node value will link the mapping to incoming message files that have no file extension.

- Example:

```
<FileExtensions>
  <Extension>.bdt</Extension>
  <Extension>.gdt</Extension>
  <Extension></Extension>
</FileExtensions>
```

In this example, the mapping is applied to all incoming message files of type *.bdt and *.gdt, as well as to all files without a file extension.

A mapping can be linked to a type of incoming message files by an expression which identifies the message type by its content. This can be done by defining a regular expression in the `ContentIdentifier` node of the mapping. Refer to chapter 11.2 Regular Expressions to learn more about how regular expressions are supported by iQ-WORKLIST.

- Example:

```
<ContentIdentifier><![CDATA[(?x-sm) (\d\d\d8000.{1,}) (?=[\r\n])]]></ContentIdentifier>
```

In this example, the related mapping is used on message files whose content starts with three numeric digits followed by the sequence "8000", one or more additional characters, and terminated by a carriage return line feed. This represents the typical starting row of a GDT message.

Split incoming message into sub-messages:

An incoming message file can contain more than one message. To separate these sub-messages from each other, the `DataSets` node of the mapping must be activated by setting its `multipliedatasets` attribute to "true." In addition, a regular expression must be defined to split the message file content into sub-messages. Refer to chapter 11.2 Regular Expressions to learn more about how regular expressions are supported by iQ-WORKLIST.

- Example:

```
<DataSets multipliedatasets="true"><![CDATA[(\d\d\d8000.*?$. *?)+]]></DataSets>
```

In this example, the incoming message is split into sub-messages where each one starts with three numeric digits followed by the sequence "8000" plus the additional characters. This represents the typical starting characters of a GDT message.

If the incoming message is split into its sub-messages, then each sub-message is handled separately for the following steps:

Map message content into DICOM worklist job data:

The `Data` node of the mapping contains the definitions of how to retrieve values from a message and how to subsequently map them to the related DICOM tag. Therefore, the `Data` node contains `DCMTag` nodes where each one represents exactly one DICOM tag, or one DICOM sequence tag. The following table describes the elements of a `DCMTag` node:

NODE ELEMENT	ELEMENT TYPE	DESCRIPTION
group	attribute	Mandatory; DICOM group identifier. Example: "0040" from DICOM tag "(0040,0100)"
element	attribute	Mandatory; DICOM element identifier. Example: "0100" from DICOM tag "(0040,0100)"

NODE ELEMENT	ELEMENT TYPE	DESCRIPTION
format	attribute	Mandatory; regular expression to merge the results delivered by the regular expression(s) defined as DCMTAG node value, or by its RegularExpression subnodes. If the RegularExpression subnodes are used, then only numbered and named placeholders are supported besides additional static characters. If the DCMTAG node value is used, then the whole PCRE syntax is supported as described for the regex_replace method in chapter 11.2 Regular Expressions.
default	attribute	Optional; default value is used if the DCMTAG's regular expression returns an empty result
dictionary	attribute	Optional; name of the dictionary that must be used to translate the DCMTAG's regular expression result. The dictionary must be defined in the dictionaries.xml file. See chapter 9.4 for dictionary details.
sequence	attribute	Mandatory on DICOM sequence, otherwise optional; must be set to "true" if the DICOM tag is a sequence. Otherwise "false" or not needed.
multisequence	attribute	Optional; used if sequence = "true" only; must be set to "true" if the sequence is allowed to have multiple items within one message.
RegularExpression	subnode	Optional; one or more regular expressions handled in the same way as the DCMTAG node value. The results are merged with help of the format attribute of the parent's DCMTAG node. This element can be used to solve complex regular expressions by splitting them into parts which are easier to handle. The RegularExpression node uses the attributes format, default, and dictionary in the same way as described for the DCMTAG node. Furthermore, it supports the attribute name which can be used for named placeholders in the format attribute of DCMTAG. Alternatively, placeholders like "\$1" can be used to merge the results of RegularExpression nodes in the order in which they are defined.
SequenceSets	subnode	Mandatory if multisequence = "true"; regular expression to split the message into message blocks. Each message block contains the data for one instance of the DICOM sequence.

See the following examples to explain several possible definition types:

- Example: Simple single regular expression

```
<DCMTAG group="0010" element="0020" format="$1" default="">
<![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3000(.{1,}) (?=[\r\n])]]></DCMTAG>
```

In this example, the value of the field "3000" is taken from a GDT message and mapped without further translation to the DICOM tag (0010,0020). This is the simplest form of using regular expressions. The format value of "\$1" just means to use the result as it is.

- Example: Split regular expression

```
<DCMTag group="0010" element="0010" format="$2^$3^^$4^$1" default="">
  <RegularExpression name="further" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3100(.{0,}) (?=[\r\n])]]></RegularExpression>
  <RegularExpression name="name" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3101(.{0,}) (?=[\r\n])]]></RegularExpression>
  <RegularExpression name="firstname" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3102(.{0,}) (?=[\r\n])]]></RegularExpression>
  <RegularExpression name="title" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3104(.{0,}) (?=[\r\n])]]></RegularExpression>
</DCMTag>
```

In this example, the value for DICOM tag (0010,0010) – Patient's Name – is merged from the results of four RegularExpression sub-nodes. The name attributes of these sub-nodes are informal in this case because numbered placeholders are used within the `format` attribute of DCMTag. Using named placeholders, the `format` attribute would look like this:

```
format="\g<name>^\g<firstname>^\g<title>^\g<further>"
```

Respecting the restrictions of XML, the final format attribute must be written as follows:

```
format="\g<name>^\g<firstname>^\g<title>^\g<further>";
```

- Example: Dictionary use and default value

```
<DCMTag group="0010" element="0040" format="$1" default="0"
dictionary="GDT FK 3110 to DICOM (0010,0040)">
  <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d3110(.{1,}) (?=[\r\n])]]></DCMTag>
```

In this example, the patient's sex is read from the field "3110" from a GDT message. Because this field is optional in GDT messages, but should be filled in DICOM messages, a default value is defined (0=unknown). But DICOM doesn't understand the values defined in the GDT specification, so the dictionary "GDT FK 3110 to DICOM (0010,0040)" defined in `dictionaries.xml` is used to translate this value to DICOM.

- Example: Simple single sequence

```
<DCMTag group="0032" element="1064" sequence="true" multisequence="false">
  <DCMTag group="0008" element="0100" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d8402(.{1,}) (?=[\r\n])]]></DCMTag>
  <DCMTag group="0008" element="0103" format="$1" default="">
    <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d9218(.{1,}) (?=[\r\n])]]></DCMTag>
  <DCMTag group="0008" element="0102" format="" default="GDT"></DCMTag>
  <DCMTag group="0008" element="0104" format="" default=""></DCMTag>
</DCMTag>
```

In this example, some data are used to fill the DICOM sequence (0032,1064) – Requested Procedure Code Sequence. This sequence is not allowed to have multiple instances so the `multisequence` attribute is set to "false."

- Example: Multi-sequence

```
<DCMTag group="0040" element="0100" sequence="true" multisequence="false">
  <DCMTag group="0040" element="0008" sequence="true" multisequence="true">
    <SequenceSets>
      <![CDATA[(?x-sm) ([\r\n]\d\d\d9876.{1,}[\r\n].*[\r\n])]]>
    </SequenceSets>
    <DCMTag group="0008" element="0100" format="$1" default="">
      <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d8402(.{1,})(?=[\r\n])]]></DCMTag>
    <DCMTag group="0008" element="0103" format="$1" default="">
      <![CDATA[(?x-sm) (?<=[\r\n])\d\d\d9218(.{1,})(?=[\r\n])]]></DCMTag>
    <DCMTag group="0008" element="0102" format="" default="GDT"></DCMTag>
    <DCMTag group="0008" element="0104" format="" default=""></DCMTag>
  </DCMTag>
</DCMTag>
```

In this example, some data are used to fill the DICOM sequence (0040,0100)>(0040,0008) – Scheduled Protocol Code Sequence. This sequence can have multiple instances within the incoming message so the multisequence attribute is set to "true." The SequenceSets node value is defined with a regular expression to split the message into message blocks which hold the information about the separate sequence instances.

Insert/Update/Delete the worklist job:

Once a DICOM tag value is separated from the incoming message and translated by the dictionary, it is given to the current worklist job. If all DICOM tags defined by mapping are handled this way, then the Actions node of the mapping comes into play. The Actions node contains two parts: First, a regular expression to get the value which represents an action defined in the Trigger node; second, a list of expected action values that relate to an action supported by iQ-WORKLIST, defined as Value nodes in the ExpectedValues node.

- Example:

```
<Actions>
  <Trigger><![CDATA[(?x-sm)\d\d\d8000(.{1,})(?=[\r\n])]]></Trigger>
  <ExpectedValues>
    <Value action="">6300</Value>
    <Value action="">6301</Value>
    <Value action="new">6302</Value>
    <Value action="">6303</Value>
    <Value action="new">6310</Value>
    <Value action="">6311</Value>
  </ExpectedValues>
</Actions>
```

In this example, to the right of the attribute "8000" in the first line of a GDT message are captured as action triggers. Expected values can be "6300," "6301," and so on. Only the values "6302" and "6310" are supported by the "new" action. This means that the DICOM tag data from the message will be inserted into the database of iQ-WORKLIST for these values. All other trigger values will result in no action being taken.

Supported action values are:

- new: inserts new data into the database
- modify: updates data in the database
- delete: deletes data from the database

iQ-WORKLIST is installed with a mapping.xml file that includes a configuration for the GDT 2.1 message format as an example.

NOTE:

iQ-WORKLIST only supports the message types described above. Furthermore, it is not possible to add other DICOM tags or action types in this version of iQ-WORKLIST.

9.4 DICTIONARY

The dictionary.xml file is another configuration file located in the config folder (%AllUsersProfile%\IMAGE Information Systems\iQ-WORKLIST\2.0). It is used to configure optional dictionaries used during the mapping process to translate values to or from DICOM.

The following example provides a typical use case: The HL7 field PID-8 (Patient Administrative Sex) of an incoming HL7 message has defined values described in HL7 table 0001. This means that the PID-8 field can have multiple values describing the administrative sex of a patient. DICOM, on the other hand, has only 3 defined values to describe the Patient's Sex.

HL7 TABLE 0001 VALUE	MAPPING	DICOM VALUE
Female – F	← →	F – Female
Male – M	← →	M – Male
Other – O	← →	O – Other
Ambiguous – A	← →	O – Other
Not applicable – N	← →	O – Other
Unknown – U	← →	O – Other

For a GDT file, the issue is similar. The identifier of the GDT patient's sex is a number and the identifier of DICOM Patient's Sex is a character.

GDT VALUE	MAPPING	DICOM VALUE
Other – 0	← →	O – Other
Male – 1	← →	M – Male
Female – 2	← →	F – Female

The dictionary.xml file consists of multiple dictionaries and each dictionary has its own XML node (Dictionary). The most important attribute of Dictionary is name. It is a unique identifier of the dictionary and used to identify the dictionary in the mapping.xml file. Another interesting attribute is default. If defined, then its value is used in every case where an item to be translated is missing in the dictionary. If it is not defined, then no translation will happen for missing items. The attributes version and lastchange are informational only and can be used by an administrator for dictionary maintenance.

Each value pair of the dictionary is defined by an item node. These nodes have two attributes. The source contains the value to be translated and the target contains the new value. Case-sensitivity is considered for the translation. The screenshot below shows the dictionary entry necessary to implement a solution for the issue described above (GDT Patient's Sex -> DICOM Patient's Sex).

```
<Dictionary name="GDT FK 3110 to DICOM (0010,0040)" default="O" version="1.0" lastchange="02.09.2013">
  <item source="0" target="O"/>
  <item source="1" target="M"/>
  <item source="2" target="F"/>
</Dictionary>
```

10 ABBREVIATIONS AND ACRONYMS

ABBREVIATION	MEANING
ACSE	Association Control Service Element
ADT	Admission, Discharge, and Transfer information for the Patient
AETitle	DICOM Application Entity Title
BDT	Behandlungsdatentransfer
DB	Database
DICOM	Digital Imaging and Communication in Medicine
DIMSE	DICOM Message Service Elements
GDT	Gerätedatentransfer
HL7	Health Level 7 Standard
ORM	Order Message: Request of an examination
SCP	Service Class Provider
MPPS	Modality Performed Procedure Steps
MWL	Modality Worklist
OMG	General Clinical Order Message
ORR	General Order Response Message
UID	Universal Identifier
XML	Extensible Markup Language

11 APPENDIX

11.1 COMMAND LINE ARGUMENTS

iQ-WORKLIST provides several command line parameters that can be used in a console window.

To use any of the following parameters:

- Open the Windows command prompt
- Navigate to the iQ-WORKLIST installation folder. (Default is C:\Program Files (x86)\IMAGE Information Systems\iQ-WORKLIST\2.0 or C:\Program Files\IMAGE Information Systems\iQ-WORKLIST\2.0 (depending on OS).)
- Type "wlsrv.exe" plus the parameter and press "Enter". For example, "wlsrv.exe REGISTER" opens the license registration dialog.

PARAMETER	DESCRIPTION
INFO	Displays the license information of a registered license
REGISTER	Brings up the dialog box to register the name and key of the purchased license
UNREGISTER	Resets the current license
--install, -i	Registers the application as an NT service
--uninstall, -u	Unregister NT service
--console, -c	Run as console application (debug mode)
--stop, -s	Stops the NT service
--help, -h, -?	Shows a list of the available parameters

11.2 REGULAR EXPRESSIONS

The regular expressions supported by iQ-WORKLIST are powered by the xpressive template library included in the boost C++ libraries version 1.54. Details about the syntax of regular expressions are described in xpressive's User's Guide:

http://www.boost.org/doc/libs/1_54_0/doc/html/xpressive/user_s_guide.html

Respecting the restrictions of XML, it is recommended that you wrap the regular expression terms by CDATA syntax if used as a node value in mapping.xml. For example:

```
<![CDATA[ regular expression ]]>
```

One easy way of using regular expressions and assigning their results to the correct DICOM value is to use the `regex_replace()` method of the *xpressive* library. Using this, we can define a mapping in the following way:

- map GDT FK 3000 to DICOM (0010,0020)
 - regular expression: **(?x-sm) (?<=[\r\n]) \d\d\d3000 (.{1,}) (?=[\r\n])**
 - **(?x-sm)** Some general flags to handle the regular expression

- **(?<=[\r\n])** There must be a carriage return line feed before
- **\d\d\d3000** The line has to start with 3 numerical digits followed by "3000"
- **(.{1,})** Create a separate result based on all characters between "3000" and the end of the line
- **(?=[\r\n])** There must be a carriage return line feed at the end
- target format: **\$1**
 - **\$1** Insert the result of the first group (It's the only group in this case)

Enabling the format sequences of Perl, we can use named groups. For example:

- map GDT FK 3103 to DICOM (0010,0030)
 - regular expression: **(?x-sm) (?<=[\r\n]) \d\d\d3103 (?P<day>\d\d) (?P<month>\d\d) (?P<year>\d\d\d\d) (?=[\r\n])**
 - **(?x-sm)** Some general flags to handle the regular expression
 - **(?<=[\r\n])** There must be a carriage return line feed before
 - **\d\d\d3103** The line has to start with 3 digits followed by "3103"
 - **(?P<day>\d\d)** Next two digits are captured as group "day"
 - **(?P<month>\d\d)** Next two digits are captured as group "month"
 - **(?P<year>\d\d\d\d)** Next four digits are captured as group "year"
 - **(?=[\r\n])** There must be a carriage return line feed at the end
 - target format: **\g<year>\g<month>\g<day>**
 - **\g<year>** Insert the result of group "year"
 - **\g<month>** Insert the result of group "month"
 - **\g<day>** Insert the result of group "day"

Because the target format is used as an attribute value in mapping.xml, it must be adapted to XML restrictions:

- target format: **\g<year>\g<month>\g<day>**

Without using named groups, but keeping in mind the order of groups, the example above could also be written as:

- map GDT FK 3103 to DICOM (0010,0030)
 - regular expression: **(?x-sm) (?<=[\r\n]) \d\d\d3103 (\d\d) (\d\d) (\d\d\d\d) (?=[\r\n])**
 - **(?x-sm)** Some general flags to handle the regular expression
 - **(?<=[\r\n])** There must be a carriage return line feed before
 - **\d\d\d3103** The line has to start with 3 digits followed by "3103"
 - **(\d\d)** Next two digits are captured as the first group
 - **(\d\d)** Next two digits are captured as the second group
 - **(\d\d\d\d)** Next four digits are captured as the third group
 - **(?=[\r\n])** There must be a carriage return line feed at the end
 - target format: **\$3\$2\$1**
 - **\$3** Insert the result of third group
 - **\$2** Insert the result of second group
 - **\$1** Insert the result of first group

11.3 FREQUENTLY ASKED QUESTIONS

11.3.1 THE IQ-WORKLIST SERVICE CANNOT BE STARTED

Potential reason

1. The license might be invalid. Check the worklist.log (INFO level) or use the command prompt to call wlsrv.exe with the parameter "INFO" to receive information about the license.
2. Formatting of the configuration.xml file is invalid. For example, XML nodes aren't closed or special characters (such as >) are used as node values.
3. The mapping.xml and dictionary.xml files don't exist.

Solution

1. See chapter 5.2 Activating the Software
2. Backup the old configuration.xml, rename it, and restart the iQ-WORKLIST service. A new configuration.xml will be created. Merge the attribute values of both files.
3. Execute the iQ-WORKLIST setup and repair the installation.

11.3.2 DICOM CONNECTION FAILS

Potential reason

1. The AE Title of the sending station is unknown.
2. Number of supported remote AE Title is limited by the license.

Solution

1. See chapter 9.1.2.1 DICOM
2. Remove unused DICOM AE Title from the Entities list in the configuration.xml file (see chapter 9.1.2.1 DICOM Entities)

11.3.3 HL7 MESSAGE REJECTED

Potential reason

1. Supported message is restricted by current license.
2. Type of the configured facility is not correct.

Solution

1. ADT messages aren't processed unless a PREMIUM license is installed.
See chapter 9.1.3.1 Facilities.

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