

PUBLIC

iQ-WORKLIST

**PD-730-158 INSTRUCTIONS FOR USE
AND ADMINISTRATION GUIDE**

Version 3.0 PUB INT EN – 001R

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TABLE OF CONTENTS

1	Introduction	4
1.1	Scope of the document	4
1.2	Purpose of the software	4
1.3	Warnings and precautions	5
2	System requirements	6
2.1	General hardware and software requirements	6
2.2	Additional system requirements	6
3	Installing the software	7
3.1	Installation	7
3.2	Launching the application	7
3.3	Upgrading the application	8
3.3.1	Upgrading from version 2.0	8
3.3.2	Upgrading from version 1.4 or 1.5	10
4	Uninstalling the software	11
5	Licensing	12
5.1	Licensing system	12
5.1.1	The license type – trial, commercial and demo licenses	12
5.1.2	The license edition – BASIC, PRO and PREMIUM	13
5.1.3	The license period – time-unlimited vs. time-limited licenses	13
5.2	Activating the software	14
6	License migration and renewal	16
6.1	Changing an existing license	16
6.1.1	Deactivating an existing license	16
6.1.2	Migrating an existing license	17
7	Maintenance	18
7.1	Hardware	18
7.2	Restore factory settings	18
7.3	Automated Clean-up	18
8	Folders and paths	20
9	Software administration	21
9.1	Configuration	21
9.1.1	Introduction	21
9.1.2	Example	21
9.1.3	General	23
9.1.4	DICOM	23
9.1.4.1	DICOM Entities	25
9.1.5	HL7	27
9.1.5.1	Facilities	27
9.1.6	Mapping	29

9.2	Workflow	30
9.2.1	Creating the worklist item/job.....	31
9.2.1.1	Required information	31
9.2.1.2	Receiving HL7 message files	33
9.2.1.3	Receiving HL7 messages via network.....	35
9.2.1.4	Retrieving proprietary message files	36
9.2.2	DICOM communication	37
9.2.2.1	Basic configuration	37
9.2.2.2	Verifying the connection.....	38
9.2.2.3	Querying the Worklist.....	38
9.2.2.4	Creating and Updating MPPS	38
9.2.3	Sending updates to the information system	40
9.2.3.1	Prerequisites	40
9.2.3.2	Transmitting HL7 via networks.....	40
9.2.3.3	Transmitting HL7 message files.....	41
9.2.3.4	Proprietary message file.....	42
9.2.3.5	Request information about performed procedure	43
9.3	Mapping	44
9.3.1	General.....	44
9.3.2	Mapping of HL7 messages	45
9.3.3	Mapping of proprietary message formats.....	47
9.3.3.1	General.....	47
9.3.3.2	Identify the right mapping.....	47
9.3.3.3	Split the incoming message into sub-messages:	48
9.3.3.4	Map the message content into DICOM worklist job data:	48
9.3.3.5	Insert/Update/Delete the worklist job:	51
9.4	Using the dictionary	52
10	Abbreviations and acronyms	53
11	List of shortcuts.....	54
12	Annex	55
12.1	Command line arguments	55
12.2	Regular expressions.....	56
12.3	Trouble-shooting	58
12.3.1	The iQ-WORKLIST service cannot be started.....	58
12.3.2	DICOM connection fails	58
12.3.3	HL7 message rejected	59
12.3.4	Modality query of the worklist shows no result or error in case of unsupported optional keys	59

1 Introduction

1.1 Scope of the document

This document represents the iQ-WORKLIST Instructions for Use and Administration Guide for software version 3.0 provided by IMAGE Information Systems Europe GmbH. Its target audience is people with technical know-how and experience concerning in-house procedures and processes for the customer's organization.

This document provides all necessary information regarding the installation and licensing of the application as well as how the software is properly maintained to fulfill its intended use.

It contains instructions concerning the configuration and set-up of the application as well as hints regarding trouble-shooting problems. The document covers the following topics, among others:

- Initial configuration
- Connecting an information system (file-based or HL7 communication)
- Connecting modalities (Worklist or MPPS communication)
- Process and log information for trouble-shooting
- Software maintenance
- Overview of all possible application settings and configuration parameters

All patient names used in this document are completely fictitious.

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We assume no responsibility for inaccurate information or descriptions of third-party products.

Disclosure level of this document is PUBLIC (PUB), which means that this document is freely available to anyone interested, such as resellers, current end users as well as potential customers. Primary color is orange.

1.2 Purpose of the software

iQ-WORKLIST is used to provide patient and study information to DICOM-compatible imaging devices (modalities) within a radiological network. It receives data in various formats (HL7, GDT, proprietary text files) and automatically converts 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.

1.3 Warnings and precautions

NOTICE:

Danger of application failures or unavailability:

All modifications to the medical software have to be made by service personnel. The risk of malfunction is relatively high when modifying software. Abnormal termination of the software as well as temporary data losses are possible when improperly administered.

Modifying application folders and or moving files to different locations, deleting or renaming them without considering other parts may cause problems in the functioning of iQ-WORKLIST. Keep the file and folder structure intact and only follow the user documentations' instruction for configuring the application.

NOTICE:

Unauthorized access to the system may cause it to cease functioning. To minimize this risk, the system should be protected by a password so that only authorized persons will have electronic access to the system. Authorized persons access the system using a password-protected Windows account.

NOTICE:

Danger of application failures or unavailability:

The capabilities and the performance of the software can be affected by limitations caused by the hardware. Therefore an appropriate setup and maintenance of the hardware is necessary (e.g. professional connection to power and network, sufficient ventilation, regular cleaning of the fan, etc.).

NOTICE:

Anti-virus software or firewalls may affect the iQ-WORKLIST software as they may accidentally block necessary application files or communication (e.g. ports). It is recommended to configure such applications accordingly to ensure the faultless running of the software on the system. A system test should be performed before using it productively.

2 System requirements

NOTICE:

The system requirements stated below are the requirements and recommendations valid at the release of this software version and/or the release date of this document.

This information is subject to change over the course of the product's life-cycle. The manufacturer will inform about updates regarding the system requirements when iQ-WORKLIST becomes available for systems other than those defined below (e.g. newer operating systems).

Contact your reseller or the manufacturer for the latest information.

Keep in mind that iQ-WORKLIST will not automatically support any new technology that becomes available on the market. The software will have to be tested before being released for such systems.

2.1 General hardware and software requirements

For iQ-WORKLIST the system requirements concerning both hardware and software are:

- CPU: Intel Core i5 with at least 1,8 GHz
- RAM: 4 GB or more
- HDD/SSD: 1 GB free hard disk space for the installation as well as files generated
- Network: at least 100 Mbit/s
- Graphics: -
- Display: -
- Periphery devices: -
- Operating systems (32 or 64 bit): Windows Server 2012 R2 Standard; Windows Server 2016 Standard; Windows Server 2019 Standard; Windows 8.1 Pro; Windows 10 Pro

2.2 Additional system requirements

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

NOTICE:

The setup file installs the new version of iQ-WORKLIST only. Due to the vast 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. Administrator permissions are required to perform the installation

The navigation through the installation wizard is straightforward and ends when the "Setup Completed" dialog appears. The setup installs external dependencies (Microsoft Visual C++ 2015-2019 Redistributable Package (x86)) and copies the program's files (application and configuration) to the hard disk. See chapter 8 for an overview of the relevant directories of iQ-WORKLIST.

The setup installs the application as a Windows service called "iQ-WORKLIST". It also adds an inbound rule to the Windows Firewall. This is important for DICOM communication via TCP/IP.

Once the installation is finished, the application runs a trial license. Refer to chapter 5 to see what limitations come with a trial and what other licenses are available.

3.2 Launching the application

The application runs as a Windows service after installation. Thus, it starts on system start up and stops on system shut down. The service can be stopped and started under "Services" in the system's "Control Panel".

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.
- The application also listens on port **2100** for incoming HL7 messages. A file-based HL7 message is not 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. Section 9.1.2 shows an example of the configuration.xml including typical

changes. The list below shows the most common changes needed before the application can be used in a productive setting.

- Section 9.1.4: Change DICOM port and AETitle
- Section 9.1.4.1: Add or modify accepted DICOM nodes
- Section 9.1.5: Change HL7 port
- Section 9.1.5: Change method of HL7 communication (file- vs. network-based)
- Section 9.3 and 9.4: Customize message format for data exchange

3.3 Upgrading the application

3.3.1 Upgrading from version 2.0

NOTICE

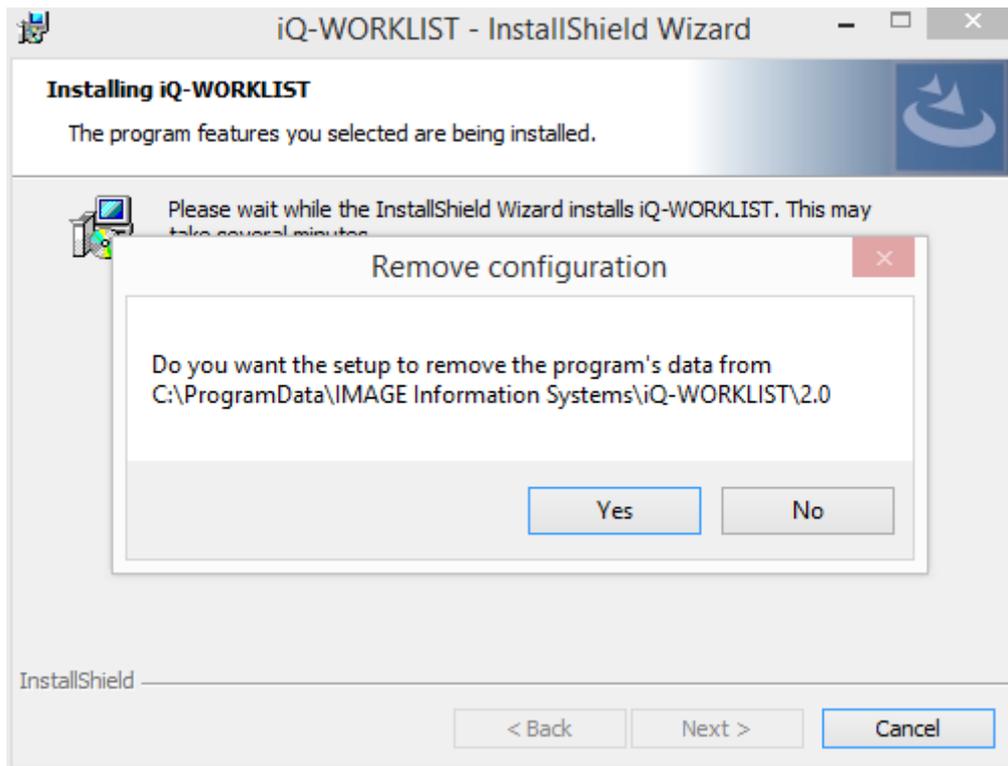
Please consider that version 3.0 introduces a brand-new solution for the distribution of MPPS updates using file-based messaging. With version 2 the template.txt could be used to notify the information system about status updates of the performed procedure. This mechanism was completely overhauled in version 3.0. See section 9.2.3.4 for details on the new mechanism.

NOTICE:

Keep in mind that an existing license for software version < 3.0 will not work with version 3.0. 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.

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.

If you want to upgrade from iQ-WORKLIST 2.0, you simply need to run the new installation file and follow the setup instructions. During the installation, a dialog pops up asking if you want to remove the old program data directory.



Remove configuration dialog

Choose "No" to migrate the existing configuration from version 2.0 to version 3.0. The configuration and patient information from the previous version is then maintained during the upgrade procedure and will be available again afterwards in %ProgramData%/iQ-WORKLIST. If you want to discard the old configuration and **start from scratch, choose "Yes"**.

An upgrade does the following changes:

- Invalidates the old license (see the notice above for more details)
- Renames the service from "iQ-WORKLIST Service" to "iQ-WORKLIST"
- Renames the application file from "wlsrv.exe" to "wlsrvserver.exe"

If you chose "No" to migrate the existing configuration, all files are moved from %ProgramData%\IMAGE Information Systems\iQ-WORKLIST\2.0 to %ProgramData%/iQ-WORKLIST. The configuration.xml is migrated on first application start. The other configuration files, i.e. mapping.xml and dictionaries.xml are not changed for compatibility reasons. If you would like to use the new supported DICOM attribute Institution Name (0008,0080), you need to manually add it to mapping.xml (see section 9.3 for instructions).

3.3.2 Upgrading from version 1.4 or 1.5

An automatic upgrade from version 1 of iQ-WORKLIST to 3.0 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 9.1.4)
 - b. HL7 configuration (see 9.1.5)
2. Merge the HL7 mapping and/or other formats (such as GDT):
 - a. HL7 mapping (see 9.3.2)
 - b. Other formats (see 9.3.3)

4 Uninstalling the software

The software can, at any time, be removed easily and safely from the system.

Follow the steps below to remove the application from the computer:

- Open the Control Panel and select "Add or Remove Programs".
- Scroll down to the entry of the iQ-WORKLIST software and click on it.
- Select "Remove" to uninstall the software.
- During the removal process, you are asked to delete the directory C:\ProgramData\iQ-WORKLIST. Confirm the dialog if you wish to completely remove all configuration files and the database.

Your current license stays on the system for the case that iQ-WORKLIST is installed again.

5 Licensing

5.1 Licensing system

A license is defined by several key characteristics:

- The license type: It distinguishes between the different use cases, i.e. the use for product evaluation, the full productive use or the use for demonstration purposes
- The license edition: It identifies the feature set that will be available in the licensed product
- The license period: It defines whether a license is valid for a specific time period or provides lifetime access to the licensed product

The following sections will give a thorough description of the individual characteristics of a license. On the basis of this information you will be able to decide which software licenses are the most effective for your institution.

5.1.1 The license type – trial, commercial and demo licenses

The license type determines the intended use case of the product. That means whether the software is used for product evaluation, for a commercial use in a productive environment or for demonstration purposes.

The following table shows all available license types and their purpose:

License type	Description
Trial	<p>These licenses are not for sale and only intended for the purpose of evaluating the software prior to purchasing a full commercial license.</p> <p>Trial licenses are always limited in time. They typically allow the evaluation of the different license editions.</p> <p>This includes the default trial license that is provided automatically after the installation of the product.</p>
Commercial	<p>These licenses must be purchased and allow the full productive use of the software.</p> <p>They are available as time-limited or time-unlimited licenses for the different license editions.</p>
Demo	<p>These licenses are not for sale and only handed out to distributors and resellers for the purpose of providing product demonstrations and technical assistance to end users.</p>

Read the following sections for more information about available license editions and license periods.

5.1.2 The license edition – BASIC, PRO and PREMIUM

The license edition determines the feature set available in the product. Some features may only be accessible in higher editions of the software.

iQ-WORKLIST supports the following editions:

Edition	Description
BASIC	This license allows the use with 2 configured DICOM nodes, but it does not allow the processing of any incoming HL7 ADT messages.
PRO	The PRO license can be used with 10 configured DICOM nodes, but it does not allow the processing of any incoming HL7 ADT messages.
PREMIUM	The PREMIUM license can be used with an unlimited number of DICOM nodes and it allows the processing of incoming HL7 ADT messages.

5.1.3 The license period – time-unlimited vs. time-limited licenses

All licenses can either be limited in time or run for the entire lifetime of the product.

Time-unlimited (lifetime) licenses will never expire, while time-limited licenses have a fixed date after which the license expires and the product becomes inaccessible.

Once expired, the license needs to be renewed to further use the application.

NOTICE

All time-limited licenses are date-sensitive. Intended or involuntary modification of the Windows system date is handled as an attempt to tamper with the license and will invalidate a time-limited license. As a result, the application can no longer be accessed. In case of date corruption, first try to set the system clock to the correct date and time. This should re-activate the license. If, after date correction, the application still does not start, contact your local reseller. Keep in mind that the issuing of a replacement key might only be possible for a fee.

5.2 Activating the software

After installing the software, iQ-WORKLIST runs by default as an evaluation version for 30 days, providing you with the opportunity to try out and evaluate the software for free. During this period the feature set is limited to that of a BASIC edition.

After the trial period ends, full licenses can be purchased and must be activated before the application is accessible again.

Before iQ-WORKLIST can be activated, the hardware fingerprint of the software must be sent to your reseller so a license key can be generated. To find the hardware fingerprint and receive the activation data for iQ-WORKLIST, go through the following steps:

- Open a Command Prompt in Windows
- Navigate to the iQ-WORKLIST installation folder (C:\Program Files (x86)\iQ-WORKLIST).
- Use the following command to show the current hardware fingerprint:
"wlserver.exe" hardware-fingerprint



```
Command Prompt
C:\Program Files (x86)\iQ-WORKLIST>"wlserver.exe" hardware-fingerprint
ADL3C-MLRTP-8PP5E-8C22A
C:\Program Files (x86)\iQ-WORKLIST>_
```

- Copy and paste the hardware fingerprint into an email and send this email to your reseller for activation. Your email should include the following information:
 - whether you want an unlimited (in time) license or a time-limited license (e.g. 1-year)
 - the number of AETs (modalities) you wish to connect and use simultaneously
 - the software version you have installed
 - your name and contact details
 - the name for which the software shall be registered
- You will receive an email in return with the registration name and license key.

After you have received the license activation data from your local reseller (registration name and license key), go through the following steps to register the license:

- Open a Command Prompt in Windows **as Administrator**.
- Navigate to the iQ-WORKLIST installation folder (C:\Program Files (x86)\iQ-WORKLIST).
- Use the following command to activate the license:
"wlserver.exe" activate-license REG_NAME LIC_KEY
where REG_NAME is the registration name and LIC_KEY the license key you received.



```
C:\Program Files (x86)\iQ-WORKLIST>"wlserver.exe" activate-license name AAABTA-G
ASLYT-5RZLP7-9PW5NK-4CD4HJ-JK5HPG-86AAAA
License activation successful.
Restarting service...
Service restarted.

C:\Program Files (x86)\iQ-WORKLIST>_
```

- If the activation is successful, a confirmation message appears and the service starts automatically.

6 License migration and renewal

This chapter describes the license migration and renewal for version 3.0 only. If you have a license for an older version and want to upgrade to version 3.0, please contact your local reseller for instructions BEFORE upgrading your software. Otherwise iQ-WORKLIST will run with a 30-days trial license.

6.1 Changing an existing license

In some cases it may become necessary to change an existing license, i.e. to enter new activation data even though a license is currently active. This may happen if:

- You wish to upgrade an iQ-WORKLIST BASIC license to iQ-WORKLIST PRO or PREMIUM.
- You wish to downgrade an iQ-WORKLIST PRO or PREMIUM license to iQ-WORKLIST BASIC.
- You wish to renew a time-limited license that is about to expire.

NOTICE:

Contact your local reseller for the procedures of changing an existing license.

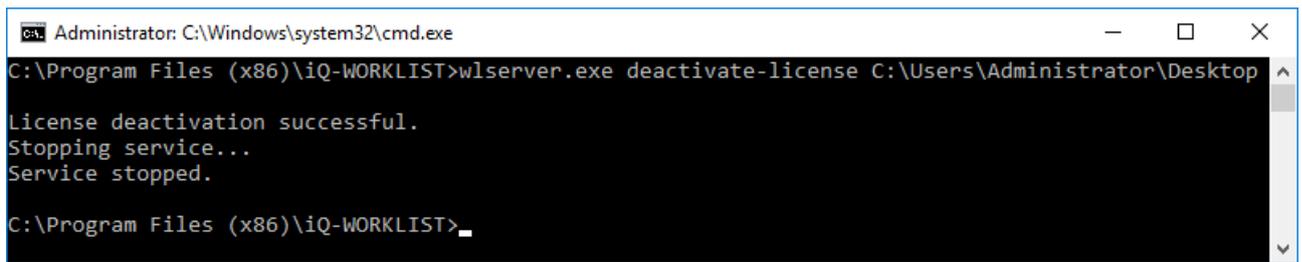
After you have received the new license activation data from your local reseller (registration name and license key), follow the instructions in section 5.2 to register the license.

6.1.1 Deactivating an existing license

When a license is removed from your current system, it will no longer be valid. The hardware fingerprint will change and the previously used activation key becomes invalid. This procedure might be necessary if you want to migrate an existing license to a different computer or if you do not wish to use the software any longer. In those cases, you have to send the deactivation information file (created while the license is removed) to your local reseller.

If you wish to remove your purchased license, you need to follow the instructions given here:

- Open a Command Prompt in Windows **as Administrator**.
- Navigate to the iQ-WORKLIST installation folder (C:\Program Files (x86)\iQ-WORKLIST).
- Use the following command to deactivate the license:
`"wserver.exe" deactivate-license FOLDER_PATH`
where FOLDER_PATH is the location for the deactivation information file. This can be an absolute path to e.g. the user's desktop or a relative path (relative to the current working directory in the Command Prompt). Simply use "." as path to put the deactivation information file into the current working directory.



```
Administrator: C:\Windows\system32\cmd.exe
C:\Program Files (x86)\iQ-WORKLIST>wlserver.exe deactivate-license C:\Users\Administrator\Desktop
License deactivation successful.
Stopping service...
Service stopped.
C:\Program Files (x86)\iQ-WORKLIST>
```

- If the deactivation is successful, a confirmation message appears and the service stops automatically.
- During the deactivation a text file (.log) will be created called "deactivation_iQ-WORKLIST_3.0_{CURRENT_DATE}.log". This file contains a deactivation key verifying the license deactivation. Keep the file; you may need it later to prove the successful deactivation. The file can be found at the provided location (the desktop in the example above).

6.1.2 Migrating an existing license

If you want to move your purchased license from one computer to another, you need to follow the instructions given here:

- Install the software on the new computer.
- Deactivate the license on the old computer as described in section 6.1.1. The hardware fingerprint will change and the previously used activation key becomes invalid.
- During the deactivation a deactivation information file (.log) is created, called "deactivation_iQ-WORKLIST_1.1_DATE.log". This file contains a deactivation key verifying the license deactivation. Send this file together with the license information of the new iQ-WORKLIST installation by email to your reseller. For details regarding the licensing process and the necessary information you need to provide, see section 5.2, "Activating the software".
- You will receive an email in return with the registered name and activation key.

NOTICE:

Keep in mind that for replacement keys a fee might be charged. Therefore, contact your reseller BEFORE you transfer your iQ-WORKLIST license to a new computer!

7 Maintenance

7.1 Hardware

The capabilities and the performance of the software can be affected by limitations and failures caused by the hardware, the network or other software installed on the system. Therefore, the proper operation and the maintenance of the hardware and network are necessary (e.g. professional connection to power and network, sufficient ventilation, regular cleaning of the fan etc.). Instructions regarding hardware and software specifications as well as software maintenance given by the manufacturers must be adhered to.

7.2 Restore factory settings

Certain settings may be changed to suit your requirements. These settings include the list of modalities, TCP ports or mappings for message exchange. However, you may want to return iQ-WORKLIST to its original settings. To restore the original default settings, do the following:

1. Open %ProgramData%\iQ-WORKLIST\config in the Windows explorer
2. Delete the file(s) that contain the settings you want to reset (e.g. mapping.xml to reset all mappings for message exchange)
3. Restart the iQ-WORKLIST service

iQ-WORKLIST recreates the files in its program data directory if they are missing.

7.3 Automated Clean-up

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 helps you to 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

Description	Path (relative to configuration.xml attributes)
"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. See section 9.1.3 for details. Once a dataset exceeds the age 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

8 Folders and paths

The following table lists all folders of the iQ-WORKLIST installation directory and their description.

The default installation directory of the application depends on whether the software is installed on a 64 bit or a 32 bit system:

- For 32 bit operating systems: C:\Program Files\iQ-WORKLIST
- For 64 bit operating systems: C:\Program Files (x86)\iQ-WORKLIST

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 located. The following table lists all files and directories used:

File	Description
Files within the program files directory	
.\	The root directory contains the main application files.
.\doc	User documentation
.\license	Definition of the license system
Files within the program data directory (%ProgramData%\iQ-WORKLIST)	
.\config\configuration.xml	Configuration file that stores all settings of the application.
.\config\mapping.xml	Configuration file that define the structure of incoming and outgoing messages (proprietary or HL7 messages)
.\config\dictionaries.xml	Configuration file that is used to translate incoming/outgoing information to/from valid DICOM values
.\data\worklist.db	Stores all information about worklist jobs and performed procedure steps
.\data\exchange*	Contains files used for text-based exchange of proprietary or HL7 messages. Can be customized. See sections 9.2.1.2 Receiving HL7 message files and 9.2.1.4 Retrieving proprietary message files for further information.
.\log\worklist.log	Log file used to protocol all interactions with the application as well as internal events

9 Software administration

9.1 Configuration

This section describes the configuration.xml file which is the main configuration file of iQ-WORKLIST. After an introduction to the file and a typical example configuration, all configuration parameters are listed and explained.

9.1.1 Introduction

When iQ-WORKLIST is started for the first time, the configuration.xml is created in "%ProgramData%\iQ-WORKLIST\config".

Any settings specified in the configuration file are applied during startup. For any settings not present, default values are assumed. Changes made to the configuration require a restart of the iQ-WORKLIST service to take effect.

NOTICE:

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 (DEBUG level) to double-check the configuration used.

9.1.2 Example

This section shows a configuration example and explains what has been changed and why. Changes are highlighted in **bold**.

```
<?xml version="1.0" encoding="UTF-8"?>
<iQ-WORKLIST version="3">
  <DICOM AETitle="WORKLIST" port="1004 MPPSOutDir="C:\ProgramData\iQ-
WORKLIST\exchange\outgoing\text" MPPSCommand="C:\UpdateInformationSystem.exe"
accNoSuffixType="Timestamp" accNoPrefix="" accNoID="0">
  <Entities>
    <Entity name="CT Room 103" AETitle="CT01" supportWarningStatus="1"/>
    <Entity name="CR Room 104" AETitle="XRAY11" characterSet="ISO_IR 100"
supportWarningStatus="1" modality="CR"/>
  </Entities>
</DICOM>
<HL7 port="2100" facilityName="IQWL" applicationName="IQWLHL7">
  <Facilities>
    <Facility name="default Name" appName="default AppName" type="TCP/IP"
inDir="C:\ProgramData\iQ-WORKLIST\exchange\incoming\hl7" outDir="C:\ProgramData\iQ-
WORKLIST\exchange\outgoing\hl7" host="127.0.0.1" port="6666" acceptAckType="ALWAYS"
applicationAckType="ALWAYS" MPPSNotification="NO"/>
  </Facilities>
</HL7>
  <Mapping mappingID="GDT mapping version 1.0" codePage="0"/>
  <General logLevel="Info" inDir="C:\Orders" maintenanceInterval="24" maxDatasetAge="30"/>
</iQ-WORKLIST>
```

- The AE Title was changed to "WORKLIST", because it provides more meaning than IQWL.
- The TCP port for DICOM communication was changed to "1004", because 104 is already in use by another application.

- iQ-WORKLIST supports incoming DICOM communication from two remote stations: CT01 and XRAY11.
 - CT01, aka the CT in room 103, supports Unicode. That's why `characterSet` was removed, because the default configuration "ISO_IR 100" narrows the character encoding to Latin1.
 - XRAY11, aka the CR in room 104, sees the studies scheduled for the CT in its worklist. This is because it sets no filter for Modality (0008,0060). iQ-WORKLIST overwrites the filter with "CR" to reduce the result set to all xray studies.
- Whenever XRAY11 or CT01 start or finish a procedure, this status change is communicated to the information system by calling the third-party application `UpdateInformationSystem.exe`.
- The information system puts new orders into "C:\Orders", which is a local directory shared in the network.
- The information system supports GDT files, that is why mapping is set to be "GDT mapping version 1.0" as specified in `mapping.xml`.

9.1.3 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
Logging			
logLevel	specific value	INFO	[DEBUG, INFO, OFF] DEBUG prints information about the program internals to the log file such as patient data, details about messages, etc. This can be useful for troubleshooting issues. During normal productive use, INFO is sufficient as it also prints hints, warnings, or fatal messages. OFF disables logging.
Message exchange			
inDir	string	"%ProgramData%\iQ-WORKLIST\exchange\incoming"	Specifies the folder to monitor for incoming file-based messages
Maintenance			
maintenanceInterval	positive integer	24	The number of hours between two maintenance jobs. 0 turns this feature off.
maxDatasetAge	positive integer	30	Defines the maximum age (in days) of stored datasets in iQ-WORKLIST

9.1.4 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
Network settings			
AETitle	string	IQWL	The DICOM AETitle of iQ-WORKLIST

Name	Type	Default	Purpose
port	positive integer	104	The local port on which iQ-WORKLIST listens for DICOM messages
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
disableGethostbyaddr	boolean	1	0 = false, 1 = true; if true then the global reverse DNS lookup is disabled on accepting associations. A value of 0 may have impact on the overall performance of the application, because a reverse DNS lookup may take a while.
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.
Message exchange			
MPPSOutDir	string	"%ProgramData %\iQ-WORKLIST\exchange\outgoing\text"	Specifies the folder where MPPS data is written
MPPSCommand	string	[empty]	A command that is executed whenever the status of a performed procedure changes. If empty, this feature is deactivated.
Accession number creation			
accNoPrefix	string	[empty]	Prefix for accession numbers generated by iQ-WORKLIST. Maximum size is 7 bytes. (Alphanumeric ASCII characters recommended). If the size is exceeded, the value is not used.

Name	Type	Default	Purpose
accNoSuffixType	specific value	TIMESTAMP	[TIMESTAMP, INCREMENTEDID] The suffix is put behind accNoPrefix. The value can either be the current datetime (TIMESTAMP) or an automatically incremented number (INCREMENTEDID) padded with 0s to a maximal length of 9 digits.
accNoID	positive integer	0	The current number of the accession number suffix if accNoSuffixType is set to INCREMENTEDID.

9.1.4.1 DICOM Entities

Inside the `DICOM` XML node, you can configure DICOM entities that need to connect to iQ-WORKLIST. 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`. All other attributes are optional

Name	Type	Default	Purpose
Identification			
name	string	[empty]	Descriptive name of the DICOM node
AETitle	string	[empty]	Application Entity Title of the DICOM node. This name must match the "Calling AETitle" of the incoming DICOM requests.
Compatibility			
supportWarningStatus	boolean	true	Determines whether iQ-WORKLIST returns warning statuses to this DICOM node. Deactivating this feature is useful if the DICOM node handles a warning status (i.e. return code: FF01) as error.

Name	Type	Default	Purpose
Modify worklist response			
characterSet	string	[empty]	Return worklist responses with the provided specific character set. Must be a "Defined Term" defined in the DICOM standard part 3 in section C.12.1.1.2 Specific Character Set. E.g. "ISO_IR 100" to force a Latin1 encoding
scheduledStationName	string	[empty]	Return worklist responses where 0040,0010 (Scheduled Station Name) matches the specified value. Use * for wild card matching. If empty, the original value from the worklist query is used.
scheduledStationAETitle	string	[empty]	Return worklist responses where 0040,0001 (Scheduled Station AE Title) matches the specified value. Use * for wild card matching. If empty, the original value from the worklist query is used.
modality	string	[empty]	Return worklist responses where 0008,0060 (Modality) matches the specified value. Use * for wild card matching. If empty, the original value from the worklist query is used.
institutionName	string	[empty]	Return worklist responses where 0008,0080 (Institution Name) matches the specified value. Use * for wild card matching. If empty, the original value from the worklist query is used.
scheduledProcedureStartDate	specific value	[empty]	[TODAY]

Name	Type	Default	Purpose
			Returns worklist responses where 0040,0002 (Scheduled Procedure Step Start Date) matches the specified date. TODAY sets 0040,0002 to the current server date. If empty, the original value from the worklist query is used.

9.1.5 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
Network settings			
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
Identification			
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

9.1.5.1 Facilities

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

NOTICE:

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
Identification			
name	string	Default name	Name of the connected facility (e.g. "RAD")

Name	Type	Default	Purpose
appName	string	Default application name	Name of the connected application
Message exchange			
type	specific value	TCPIP	[TCPIP, FILE] The facility can either send/receive HL7 message via the network (TCPIP) or via a file system (FILE).
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.
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.
File-based message exchange			
inDir	string	"%ProgramData%\iQ-WORKLIST\exchange\incoming\HL7"	This is the watched directory for incoming file-based HL7 communication (type = FILE)
outDir	string	"%ProgramData%\iQ-WORKLIST\exchange\outgoing\HL7"	This is the directory for all outgoing messages created by iQ-WORKLIST (type = FILE)
Network-based message exchange			
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)

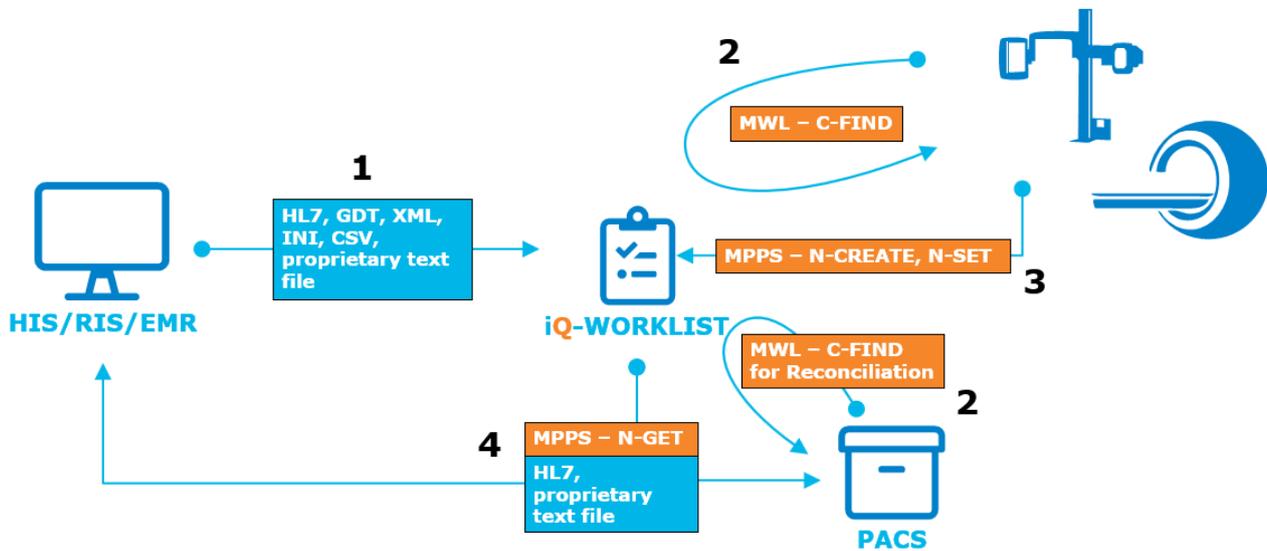
9.1.6 Mapping

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

Name	Type	Default	Purpose
mappingID	string	[empty]	<p>Preset mapping for incoming text files. Must be equal to the ID specified in mapping.xml. E.g. "GDT mapping version 1.0"</p> <p>If empty, iQ-WORKLIST tries to determine the correct mapping based on the file extension or file content using a regular expression defined in mapping.xml. See section 9.3 for details.</p> <p>(Mapping for HL7 messages is based on the MSH segment of the message)</p>
codePage	positive integer	0	<p>Preset Windows code page used to convert 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. Frequently used values are 1252 (Latin 1 / Western European) or 65001 (Unicode UTF-8).</p>
timeOut	positive integer	1	<p>This configures the amount of time (in seconds) that iQ-WORKLIST waits after a new file has been added to the configured input directory until it actually reads the file. This can be necessary e.g. if the application supplying the input file first creates an empty file and fills it afterwards or if the file is filled through multiple write operations. If set to 0 the file is processed immediately, which may have unintended side effects (e.g. processing an empty file).</p>

9.2 Workflow

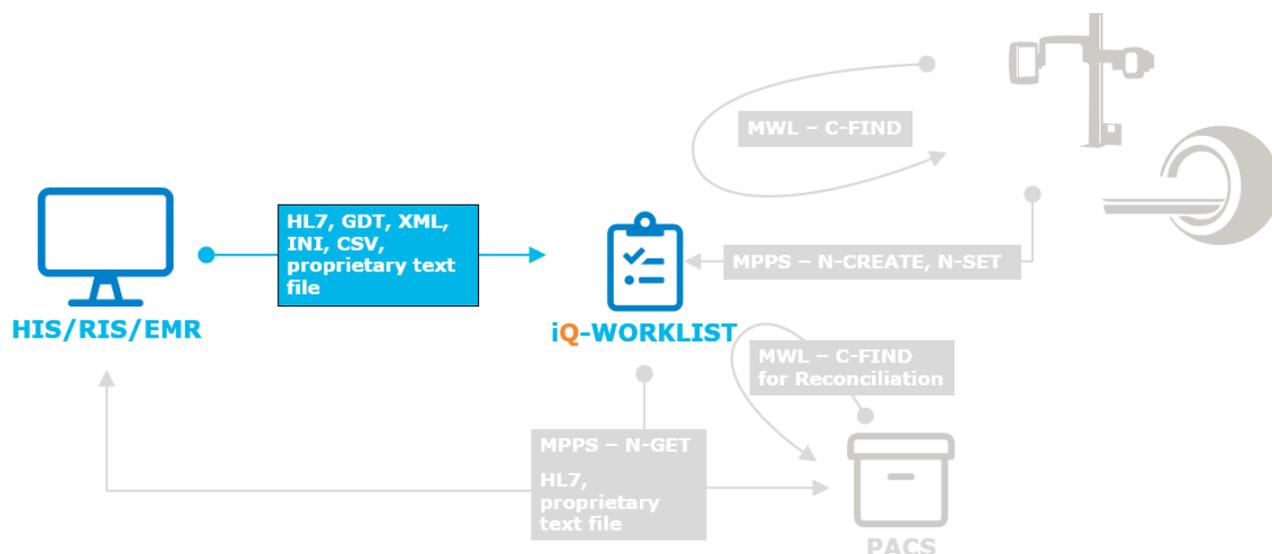
The following picture describes the common workflow of iQ-WORKLIST.



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. A PACS may also query the worklist for reconciliation (e.g. merging two patient records to a single record).
3. The modality sends information about the performed procedure (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 procedure using HL7 or a proprietary message format. Connected DICOM entities can also query information about a performed procedure.

This section goes through the whole workflow starting with how an information system is going to create a worklist job, continuing with how the worklist job gets to the modality and finally how the information system gets feedback about the status of the study.

9.2.1 Creating the worklist item/job



This section lists the required information for a worklist job and shows the various ways to create those.

9.2.1.1 Required information

A worklist job is created by file- or network-based communication. 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. The recommendation column shows whether an information is important or optional.

Attribute	Description	Recommendation
(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	

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

Attribute	Description	Recommendation
(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 creates one automatically.
- **RECOMMENDED:** It is recommended that the information system provides a value for this attribute.

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.

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

Accession numbers are often used by information systems as identifiers for studies. If it is not provided, iQ-WORKLIST generates an accession number based on a configured pattern. The attributes `accNoSuffixType` and `accNoPrefix` within the `configuration.xml` determine this pattern. Refer to section 9.1.4 for details on the automated creation of accession numbers.

9.2.1.2 Receiving 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. The facility has its own XML node and the configuration is set by changing the attributes of this node.

To enable file-based communication, the attribute `type` has to be set to `FILE`.

Attribute	Description
<code>inDir</code>	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\iQ-WORKLIST\exchange\incoming\hl7").
<code>outDir</code>	This attribute defines the location where the response HL7 files generated by iQ-WORKLIST are stored. (Example: "C:\ProgramData\iQ-WORKLIST\exchange\outgoing\hl7"). This outgoing directory has its own structure and is based on the facility name and the type of response message.

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 keeping the configured `inDir` clean.

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 the 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 the 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 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 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")

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

9.2.1.3 Receiving HL7 messages via network

iQ-WORKLIST is able to retrieve and send HL7 messages via TCP/IP communication. The HL7 server is configured in the configuration.xml file. To enable network-based communication, the attribute `type` has to be set to TCPIP.

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`. The following attributes are relevant for TCP-based communication.

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).
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 the following values:

- ALWAYS: An accept acknowledgement (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 the 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 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")

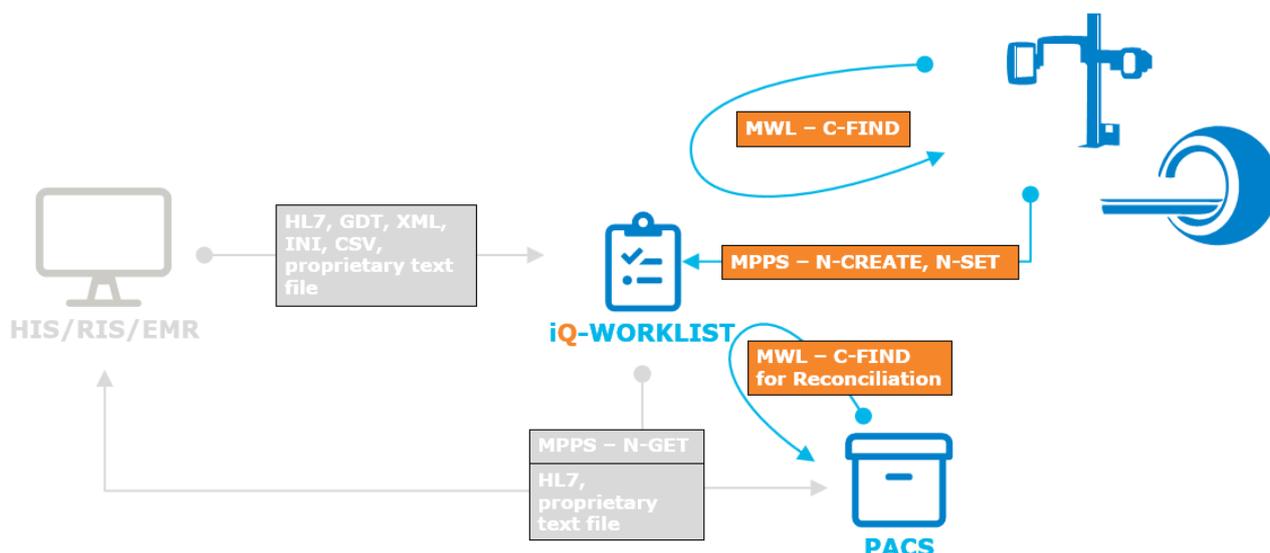
For more information about incoming and outgoing HL7 messages, refer to the iQ-WORKLIST HL7 Conformance Statement.

9.2.1.4 Retrieving proprietary message files

iQ-WORKLIST is able to retrieve proprietary, file-based messages from a folder. The incoming folder is configured in the attribute `inDir` of the `general` node in the `configuration.xml` file. A message file put into this directory is processed by iQ-WORKLIST. A mapping is used to extract the required information for the worklist job (see section 9.3.3 for details about mapping configuration). After an incoming file has been processed successfully, it is moved to a subfolder of `inDir` named "done". If processing message failed, it is moved to the "error" subfolder instead. These subfolders help keep the `inDir` folder clean of messages that have been processed.

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

9.2.2 DICOM communication



This section addresses the basic DICOM configuration and the supported DICOM activities which are verification (C-ECHO), worklist query (C-FIND) and performed procedure management (N-CREATE, N-SET).

9.2.2.1 Basic configuration

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

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 uses a whitelist to manage its communication partners – it must know the requesting station (`AETitle`) or it refuses 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, has one sub node per requesting station called `Entity`. For example, the following `Entity` node allows the station with the AET "CT001" to communicate with iQ-WORKLIST.

```
<Entity name="CT 2nd floor" AETitle="CT001"/>
```

The example shows the basic configuration of an entity. Further attributes are supported to address compatibility issues and preset filters for individual entities. See section 9.1.4.1 for a list of all supported attributes. Detailed information about the supported SOP classes and their DICOM attributes can be found in the DICOM Conformance Statement of iQ-WORKLIST.

9.2.2.2 Verifying the connection

In order to verify the availability of the DICOM server, send a C-ECHO to iQ-WORKLIST. 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 section 9.2.2.1 for further information about the configuration of the DICOM server.

9.2.2.3 Querying the Worklist

A worklist query (C-FIND) returns a list of worklist jobs. In order to reduce the complexity of the resulting list, the modality can set values for certain attributes within the request. These values act as filters (aka matching keys). A full list of the supported DICOM attributes, including the ones that can be used as filters, can be found in the iQ-WORKLIST DICOM Conformance Statement.

If a modality does not support a certain filter / matching key, e.g. it does not support the modality attribute (0008,0060), iQ-WORKLIST allows for specifying a value in the configuration.xml. For example, the following `Entity` node allows the modality to request scheduled CT procedures only, though the modality does not support this DICOM attribute.

```
<Entity name="CT 2nd floor" AETitle="CT001" modality="CT"/>
```

or

```
<Entity name="CT 2nd floor" AETitle="CT001" institutionName="Hospital*"/>
```

In the second example, a wildcard is used to filter by the DICOM attribute Institution Name (0008,0080). The result contains all procedures scheduled for "Hospital A", "Hospital B" and "Hospital C" but not "Radiology A".

All available filters can be found in section 9.1.4.1.

9.2.2.4 Creating and Updating MPPS

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

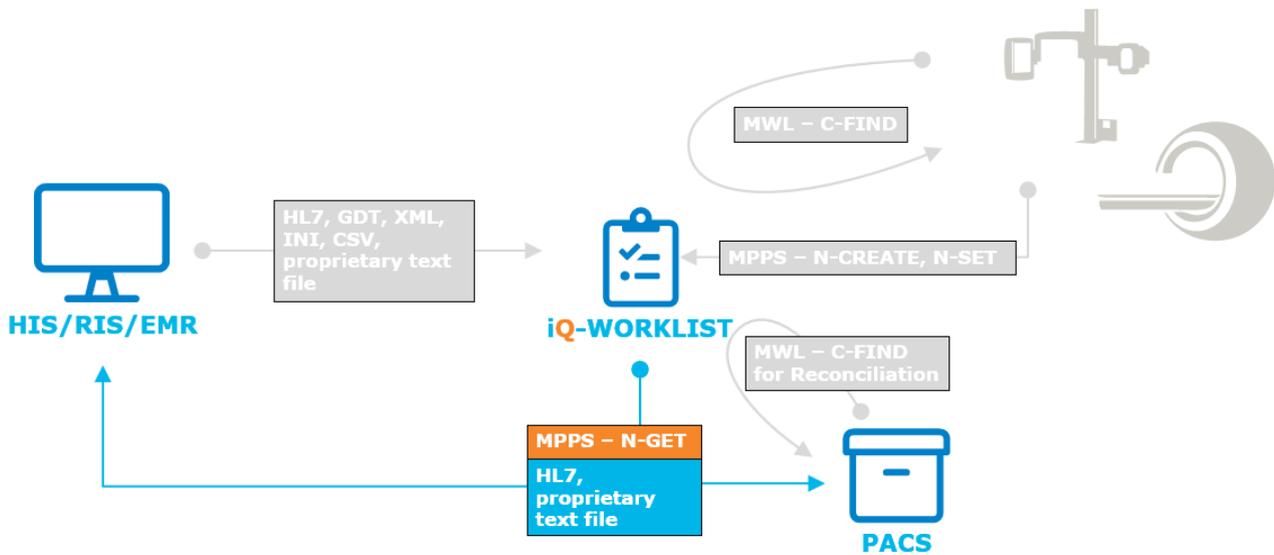
- Status of the performed procedure
- End date and time of the procedure
- Performed series information
- Radiation dose
- Billing data
- Exposure dose
- Film consumption

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



This section informs about the prerequisites of this feature and describes the different ways of keeping the information system up-to-date.

9.2.3.1 Prerequisites

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. 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.

9.2.3.2 Transmitting HL7 via networks

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. It is necessary that the procedure was scheduled by the information system in the first place. When the procedure was scheduled using an ORM^O01 message, iQ-WORKLIST uses an ORR^O02 message to send updates back to the

information system. Procedures scheduled using the ORG^O19 message trigger an ORG^O20 response 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

To enable network-based communication, the attribute `type` has to be set to TCPIP.

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 has 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")

9.2.3.3 Transmitting HL7 message files

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. To enable file-based communication in the first place, the attribute `type` has to be set to FILE.

Attribute	Description
<code>outDir</code>	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.

9.2.3.4 Proprietary message file

File-based message exchange comes with the disadvantage that their structure is not defined by a standard (i.e. the message format is proprietary). That is why this feature does not work out of the box and is disabled by default. It needs additional labor to enable it.

iQ-WORKLIST allows for specifying a command that is executed whenever the status of a performed procedure changes. It is set up by changing the `MPPSCommand` attribute in the `configuration.xml` (see section 9.1.4). It must be an executable that accepts a single argument. The argument passed to the executable is a path to a json file that holds all information about the performed procedure. The application needs to parse this information from the json file and send it to the information system.

With this configuration

```
MPPSCommand="C:\UpdateInformationSystem.exe"
```

or (if the location is available in the system-wide PATH variable)

```
MPPSCommand="UpdateInformationSystem.exe"
```

iQ-WORKLIST would execute

```
C:\UpdateInformationSystem.exe "PATH_TO_OUT_DIR\{6cd779c9-102d-40d1-a8c2-2b27b9c155c0}.json"
```

Where `PATH_TO_OUT_DIR` is the output directory configured in `MPPSOutDir` (see section 9.1.4). The json files are kept in the output directory until maintenance removes them (see section 7.3 for details on the built-in maintenance mode).

This following example showcases the possibilities of the interface. It builds the text *"The CT Abdomen for Doe^John (1.2.826.0.1.3680043.2.360.34.3542449326.11036.1595401596.698) is COMPLETED"*. In a real use case, the information extracted from the json file should be passed to the information system using an application programming interface.

Command (requires an installed Python interpreter):

```
MPPSCommand="&quot;C:\Program Files\Python\python.exe&quot;; &quot;C:\Program Files (x86)\iQ-WORKLIST\CreateMessage.py&quot;;"
```

NOTICE

Special characters such as " need to be escaped as ";

Executed command:

```
"C:\Program Files\Python\python.exe" "C:\Program Files (x86)\iQ-WORKLIST\CreateMessage.py" "C:\ProgramData\iQ-WORKLIST\exchange\outgoing\text\{6cd779c9-102d-40d1-a8c2-2b27b9c155c0}.json"
```

Content of the CreateMessage.py script file:

```
import sys
import json

# get path to json file
file_path = sys.argv[1]
# open file to read content
with open(file_path) as json_file:
    # parse content as json
    data = json.load(json_file)
    # process file content
    performed_procedure = data["performed_procedure_steps"]
    scheduled_procedure = performed_procedure["scheduled_procedure_steps"][0]
    mpps_status = performed_procedure["status"]
    modality = scheduled_procedure["modality"]
    description = scheduled_procedure["description"]
    study_instance_uid = scheduled_procedure["requested_procedures"]["study_instance_uid"]
    patient_name = scheduled_procedure["requested_procedures"]["imaging_service_requests"][
        "patients"]["name_dicom"]
    message = 'The {mod} {desc} for {name} ({study_uid}) is {status}'.format(
        mod=modality, desc=description, name=patient_name, status=mpps_status,
        study_uid=study_instance_uid)
```

9.2.3.5 Request information about performed procedure

An information system can use the DICOM N-GET message to request information about performed procedures. This method is an alternative to the others and it is different in many aspects. While the other methods are unsolicited messages sent from iQ-WORKLIST to the information system, this method is a query initiated by the information system. It is a DICOM message and therefore the sending station must be known to iQ-WORKLIST. See section 9.2.2.1 for more information about the basic DICOM configuration. An N-GET query requires the instance UID of the respective performed procedure. This ID has to be obtained by means of one of the other methods listed above.

9.3 Mapping

9.3.1 General

Mapping for incoming files is configured in the mapping.xml file within the program data folder (%ProgramData%\iQ-WORKLIST\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="XML mapping version 1.0">
250
251    <Mapping ID="HL7 ORM O01 mapping version 1.0">
508
509    <Mapping ID="CSV mapping version 1.0">
753
754    <Mapping ID="GDT mapping version 1.0">
1053
1054    <Mapping ID="ORM^O01">
1288
1289    <Mapping ID="OMG^O19">
1523
1524    <Mapping ID="ADT^A08">
1602
1603    <Mapping ID="ADT^A40">
1631
1632    <Mapping ID="ACK">
1656
1657    <Mapping ID="ORR^O02">
1876
1877    <Mapping ID="ORG^O20">
2095  </MappingConfiguration>
```

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 [Microsoft](#)). 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 your system code page is used. You find this information when you start iQ-WORKLIST and take a look into the log file (DEBUG level). If the system 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).

iQ-WORKLIST distinguishes between two types of mapping: HL7 and proprietary file formats. While an HL7 mapping uses the identifier defined by the HL7 standard, proprietary file formats are mapped by using regular expressions. A few proprietary formats are provided and can be used as template. This includes GDT, XML and CSV.

9.3.2 Mapping of HL7 messages

iQ-WORKLIST uses this mapping to parse incoming and create outgoing HL7 message. It is used for file-based as well as network-based communication.

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 nested 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 Data 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 FileExtension 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 style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <!-- (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 DCMTag XML node represents one DICOM attribute. The attributes group and element define the tag of the DICOM attribute. The value of the DCMTag node is the value to be inserted. The attribute dictionary can be filled with the name of a defined dictionary in the dictionary.xml file. This is important for incoming/outgoing values which need to be translated to/from DICOM (e.g. Patient's Sex). Please refer to section 9.4 for more information about the dictionary.xml 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</p>

XML Node	Description
	<p>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 (e.g. PID-11.1.1) <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 reads PID-2 instead.</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" causes 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 section 9.2.1.1 for a complete list of required attributes.

9.3.3 Mapping of proprietary message formats

9.3.3.1 General

iQ-WORKLIST uses mapping of proprietary message formats to parse general file-based messages received in the `inDir` folder (see section 9.2.1.4 for a general description of the file-exchange).

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

The details are explained in the following sections.

9.3.3.2 Identify the right mapping

If iQ-WORKLIST receives a file-based message, it first tries to find the mapping which best fits the message. The application follows these three steps to determine the mapping:

1. Check preset in configuration.xml

The mapping can be preset in `mappingID` in configuration.xml file only if one mapping is used for all incoming message files. E.g. `mappingID="GDT mapping version 1.0"` matches the mapping for GDT files. The ID is defined in the `ID` attribute of the `Mapping` node in mapping.xml.

2. Check file-extension against definitions in mapping.xml

If no mapping is preset, then iQ-WORKLIST compares the file extension of the incoming message file with all mappings in the order they are defined in mapping.xml. The first mapping with a matching file extension is used. E.g.

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

This matches *.gdt, *.bdt and files without a file extension.

3. Check file content against definition in mapping.xml

If no mapping matches, then iQ-WORKLIST checks the content of the incoming message using the regular expression defined in `ContentIdentifier` in mapping.xml. Refer to section 12.2 Regular expressions to learn more about how regular expressions are supported by iQ-WORKLIST. Again, the first mapping that matches is used. E.g.:

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

This matches a message that starts with three numeric digits followed by the sequence "8000", one or more additional characters, and is terminated by a carriage return + line feed. This definition describes the first line of a GDT message.

If still no mapping fits, then no mapping is done and the message is rejected.

9.3.3.3 Split the incoming message into sub-messages:

An incoming message file can contain more than one order. To separate these orders from each other, the `DataSets` node of the mapping must be activated by setting its `multipledatasets` attribute to "true". In addition, a regular expression must be defined to split the message file content into orders. Refer to section 12.2 Regular expressions to learn more about how regular expressions are supported by iQ-WORKLIST.

- Example:

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

In this example, the incoming message is split into multiple orders 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 multiple orders, then each order is handled separately.

9.3.3.4 Map the 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 <code>DCMTag</code> node value, or by its <code>RegularExpression</code> subnodes. If the <code>RegularExpression</code> subnodes are used, then only numbered and named placeholders are supported besides additional static characters. See section 12.2 for details on regular expressions and how to use them to parse values from an incoming order file.
default	attribute	Optional; default value is used if the <code>DCMTag</code> 's regular expression returns an empty result.
dictionary	attribute	Optional; name of the dictionary that is used to translate the <code>DCMTag</code> 's regular expression result. The dictionary must be defined in the <code>dictionaries.xml</code> file. See section 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 <code>sequence</code> = "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 <code>DCMTag</code> node value. The results are merged with help of the <code>format</code> attribute of the parent's <code>DCMTag</code> node. This element can be used to solve complex regular expressions by splitting them into parts which are easier to handle. The <code>RegularExpression</code> node uses the attributes <code>format</code> , <code>default</code> , and <code>dictionary</code> in the same way as described for the <code>DCMTag</code> node. Furthermore, it supports the attribute <code>name</code> which can be used for named placeholders in the <code>format</code> attribute of <code>DCMTag</code> . Alternatively, placeholders like "\$1" can be used to merge the results of <code>RegularExpression</code> nodes in the order in which they are defined.
SequenceSets	subnode	Mandatory if <code>multisequence</code> = "true"; regular expression to split the message into message blocks. Each message block contains the data for one instance of the DICOM sequence.

The following examples 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. If you would use 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&lt;name&gt;^\g&lt;firstname&gt;^^\g&lt;title&gt;^\g&lt;further&gt;"
```

- 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). As the values defined in DICOM are incompatible with the definitions in the GDT specifications, the dictionary “GDT FK 3110 to DICOM (0010,0040)” is used to translate the values from GDT to DICOM. The dictionary is defined in dictionaries.xml.

- 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, the Requested Procedure Code Sequence (0032,1064) is filled with data. 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, the Scheduled Protocol Code Sequence (0040,0100)>(0040,0008) is filled with data. 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.

9.3.3.5 Insert/Update/Delete the worklist job:

Once the order is mapped, the `Actions` node 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 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, the text behind "8000" in the first line of a GDT message is captured as action trigger. Expected values can be "6300," "6301," and so on. Only the values "6302" and "6310" trigger the action "new". This means that the order is inserted into the database of iQ-WORKLIST. All other trigger values result in no action being taken.

Supported action values are:

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

9.4 Using the dictionary

The dictionary.xml file is a configuration file located in the config folder (%ProgramData%\iQ-WORKLIST\config). It is used to configure 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) has a set of defined values specified in the HL7 standard. These values are only partly compatible with the values defined by the DICOM standard and thus need to be translated.

HL7 value	DICOM value	Meaning
F	F	Female
M	M	Male
O	O	Other
A	O	Ambiguous
N	O	Not applicable
U	O	Unknown

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 takes place 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. The `source` value has to match exactly; i.e. no wildcard support, `source` is case-sensitive. The screenshot below shows the dictionary entry necessary to implement a solution for the issue described above (HL7 Patient Sex -> DICOM Patient's Sex).

```
<Dictionary name="HL7 Patient Sex">
  <item source="M" target="M"/>
  <item source="F" target="F"/>
  <item source="O" target="O"/>
  <item source="A" target="O"/>
  <item source="N" target="O"/>
  <item source="U" target="O"/>
</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 List of shortcuts

Not applicable.

12 Annex

12.1 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)\iQ-WORKLIST or C:\Program Files\iQ-WORKLIST (depending on OS).)
- Type "wlserver.exe" plus one of the parameters listed below and press "Enter". For example, "wlserver.exe -?" shows a list of all available parameters.

Parameter	Description
-help, -?	Displays the help and shows a list of the available parameters.
-install	Installs the Windows service.
-uninstall	Uninstalls the Windows service.
-console	Run as console application (debug mode)
activate- license <registration name> <license key>	Activates a new license using the given registration name and license key and restarts the service. This command needs to be run as Administrator . E.g. <pre>wlserver.exe activate-license YOUR_NAME AAAA-BBBB-CCCC</pre> The command activates the key AAAA-BBBB-CCCC that was issued for YOUR_NAME.
deactivate- license <deactivation folder path>	Deactivates the current license and writes the 'deactivation file' to the given directory. Once the license is deactivated, the application can no longer be used. This command needs to be run as Administrator . E.g. <pre>wlserver.exe deactivate-license "%cd%"</pre> The command deactivates the current license and put the deactivation file into the current working directory of the command prompt.
hardware- fingerprint	Outputs the current hardware fingerprint necessary for license activation of the product.
license-info	Outputs all information about the currently activated license of the product.
save-license- log <output file path>	Writes the license log file to the given location. The output file path should end with the file extension '.log', e.g. ".\license.log" <pre>wlserver.exe save-license-log ".\license.log"</pre> The command writes the file into the current working directory.

12.2 Regular expressions

The regular expressions supported by iQ-WORKLIST are powered by the xpressive template library included in the boost C++ libraries version 1.68. Details about the syntax of regular expressions are described in xpressive's User's Guide:

https://www.boost.org/doc/libs/1_68_0/doc/html/xpressive/user_s_guide.html

Respecting the restrictions of XML, it is recommended that you wrap the regular expression terms in a CDATA block if used as a node value in mapping.xml. This prevents the need to escape special characters which would otherwise cause syntax errors. For example:

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

One easy way of building regular expressions to assign their results to the correct DICOM value is to use an online tool such as www.regex101.com. Together with a sample message you can optimize the regular expression.

```
01380006310
0183000PatID12345
0173101LastName
0183102FirstName
017310321011986
01031101
0273701ReferringPhysician
0256220StudyDescription
0188410AccNo12345
0118402DICO02
```

Using the tool and a sample message, we can define a mapping in the following way:

- Map Patient ID (0010,0020) from GDT (field 3000)
 - Regular expression: **(?x-sm) (?<=[\r\n]) \d\d\d3000 (.{1,}) (?=[\r\n])**

Sub expression	Meaning
(?x-sm)	General flags to handle the regular expression. A dot won't match a line break so that a match stops at the end of a line. Multi-line support is disabled.
(?<=[\r\n])	A match starts with a carriage return + line feed (a line break on Windows platforms).
\d\d\d3000	After the line break, a match continues with three digits followed by "3000".
(.{1,})	After this, one or more arbitrary characters follow. This is the value we are looking for and therefore it is captured in braces. Braces are used to mark so-called capture groups within a regular expression.

Sub expression	Meaning
(?=[\r\n])	The match ends when a carriage return + line feed was found (i.e. a line break).

- Target format: **\$1**
 - **\$1** Use the result of the first capture group (it is the only group in this case)

The following example showcases multiple named capture groups.

- Map Patient Birth Date (0010,0030) from GDT (field 3103)
 - 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])**

Sub expression	Meaning
(?x-sm)	General flags to handle the regular expression. A dot won't match a line break so that a match stops at the end of a line. Multi-line support is disabled.
(?<=[\r\n])	A match starts with a carriage return + line feed (a line break on Windows platforms).
\d\d\d3103	After the line break, a match continues with three digits followed by "3103".
(?P<day>\d\d)	After this, two digits follow that represent the day. A capture group named "day" is used to extract this information.
(?P<month>\d\d)	After this, two digits follow that represent the month. A capture group named "month" is used to extract this information.
(?P<year>\d\d\d\d)	After this, four digits follow that represent the year. A capture group named "year" is used to extract this information.
(?=[\r\n])	The match ends when a carriage return + line feed was found (i.e. a line break).

- Target format: **\g<year>\g<month>\g<day>**
 - **\g<year>** Use the result stored in the capture group "year"
 - **\g<month>** Use the result stored in the capture group "month"
 - **\g<day>** Use the result stored in the capture 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>**

12.3 Troubleshooting

12.3.1 The iQ-WORKLIST service cannot be started

Potential reason

1. The license might be expired or invalid. Check the `worklist.log` (INFO level) for errors or run the command `wlserver.exe license-info` to output information about the license.
2. Formatting of the `configuration.xml` file is invalid. For example, XML nodes are not closed or special characters (such as `>`) are used as node values.
3. The DICOM port is blocked (see `worklist.log` file).
4. The application cannot access a shared folder. The `worklist.log` file shows the error "Failed to create directory '...' operation not permitted".
5. The application cannot access a mapped drive. The `worklist.log` file shows the error "Failed to create directory '...' operation not permitted".

Solution

1. Activate a new license (see section 5.2)
2. Backup the old `configuration.xml` (i.e. rename it) and restart the iQ-WORKLIST service. A new `configuration.xml` is created. Merge your changes and regularly restart the service to identify the issue.
3. Make sure that the TCP port that is used by iQ-WORKLIST (default: 104) is not in use by another application. You may also change the port used by iQ-WORKLIST in `configuration.xml` (see section 9.1.4). Keep in mind that changing the port may require additional configuration on other ends (e.g. modalities).
4. The application runs as a service under the local system user SYSTEM. This user is not allowed to access the shared folder. Either share a folder on the worklist service machine and use this folder for message exchange or run the service as a user that has access to the shared folder. The latter can be done by using a dedicated Windows domain account.
5. The application has to run in a user session to be able to access mapped drives. To do so run the command `wlserver.exe -console`. This has the disadvantage that a user has to be logged in all the time. The user sessions must not be closed. This workaround works against all advantages of a Windows service and is therefore not recommended in a productive environment. Instead you should share the location where the mapped drive is pointing to and access it as a network share.

12.3.2 DICOM connection fails

Potential reason

1. The AE Title of the sending station is unknown. Check the worklist.log file for the "bad sender AE" error.
2. Number of supported remote AE Title is limited by the license. Run the command `wlserver.exe license-info` and compare the "Number of DICOM nodes" against the number of `Entity` nodes in your configuration.xml. Is the number of `Entity` nodes greater than the "Number of DICOM nodes"?

Solution

1. You have to add your sending station (e.g. modality) to the list of known entities in configuration.xml. See section 9.1.4.1 for a list of all necessary information.
2. Remove unused DICOM AE Titles (`Entity` node) from the `Entities` list in the configuration.xml file (see section 9.1.4.1 DICOM Entities)

12.3.3 HL7 message rejected

Potential reason

1. Supported message is restricted by current license. ADT messages are supported by a PREMIUM version only.
2. Type of the configured facility is not correct. Check the `type` attribute in configuration.xml. Does it have the desired value (FILE vs. TCPIP).

Solution

1. If you want to use ADT messages, you need to activate a PREMIUM license. See section 5.2 for details on license activation.
2. Set the correct type and restart the iQ-WORKLIST service. If you want to send HL7 messages via network, set type to TCPIP. If you want to use file-based communication, set type to FILE. See section 9.2.1.2 for file-based messaging and 0 for network-based messaging.

12.3.4 Modality query of the worklist shows no result or error in case of unsupported optional keys

Potential reason

1. The modality queries the worklist, but the worklist does not show a result or even an error. The worklist.log file (DEBUG level) contains the C-FIND Response with the status FF01.

Solution

1. Disable the configuration option `supportWarningStatus` and restart the iQ-WORKLIST service. See section 9.1.4.1 for details on the configuration.



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