Integrating the Healthcare Enterprise

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IHE Radiology

Technical Framework Supplement

10
CT/MR Perfusion Imaging with Contrast (PERF)

Trial Implementation

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This is a supplement to the IHE Radiology Technical Framework Rev. 9.0.

It is submitted for Trial Implementation as of June 21, 2009. Comments are invited and may be submitted on the IHE forums at http://forums.rsna.org/forumdisplay.php?f=12 or by email to
25 radiology@ihe.net.

General Information about IHE® may be found at: www.ihe.net.

Information about the IHE Radiology domain may be found at: http://www.ihe.net/domains/index.cfm.

30 Information about the structure of IHE Technical Frameworks and Supplements may be found at: http://www.ihe.net/about/process.cfm and http://www.ihe.net/profiles/index.cfm.

The current version of the IHE Radiology Technical Framework may be found at: http://www.ihe.net/technical_framework/index.cfm.

Editor's Note
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This supplement describes the changes to the existing technical framework documents and where indicated amends text by addition (**bold underline**) or removal (**bold strikethrough**), as well as addition of large new sections introduced by editor's instructions to "add new text" or similar, which is not bolded or underlined for readability.

40 "Boxed" instructions like the sample below indicate to the volume editor how to integrate the relevant section(s) into the relevant Technical Framework volume:

Replace Section X.X by the following:

45 **<u>CONTENTS</u>**

Introduction

65   This supplement adds a new profile to the IHE Radiology Technical Framework to address interoperability of Contrast Perfusion imaging data encoded as Enhanced CT/MR DICOM objects.

There are no new actors or transactions defined.

Additions are made to the following transactions:

- RAD-8 Modality Images Stored
70   - RAD-16 Retrieve Images

Profile Abstract

The CT/MR Perfusion Imaging with Contrast Integration Profile facilitates the exchange of contrast enhanced images containing standard attributes for timing and position. The exchange of these attributes allow for correct and convenient display. Applications using the older single-
75   frame DICOM image objects depended on proprietary assumptions about which timing attributes were expected to be present, and were not generally interoperable.

Open Issues and Questions

Closed Issues

80   1. Which attribute should be used for the actual time: TemporalPositionIndex (is type 3) or Frame Reference DateTime (0018,9151)?
        Answer: TemporalPositionIndex will be made required.

2. Can we assume all images will be frames in a single Enhanced CT or MR SOP Instance.

85   *Answer: No, there could be a need for multiple SOP Instances. E.g., the site might choose to acquire additional frames after the first acquisition is completed.*

Answer: The committee decided to cover the 80 – 90% of situations where only one Perfusion object is allowed containing all original images, The object may potentially be split into multiple DICOM objects with the same Concatenation UID according to
90   *the DICOM rules.*

3. Is it necessary to display Contrast Usage attributes as listed in table 4.16.4.2.2.n-1? Table 4.16.4.2.2.n-1 mandates a list of displayed attritues. Are more attributes required?

Answer: TemporalPositionIndex, StackID and InStackPositionNumber

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4. Do we need to express image flavors other than PERFUSION?

95 Currently, the value of Image Type and Frame Type value 3 are both required to be PERFUSION. This excludes the use of values such as PRE_CONTRAST and POST_CONTRAST. In addition, DICOM WG-16 is working on PERFUSION_ASL. Should Series Description Code Sequence to be used for indicating perfusion (CP-860)?

100 *Answer: No, the use case is limited to PERFUSION*

5. What should Display systems be required to do when there are frames for a single perfusion series in <u>multiple</u> Enhanced CT or MR SOP Instances?
In exceptional cases the clinician may decide to have additional images aquired after reviewing acquired images (the patient not having left the table). The current profile
105 text requires the display to treat all related SOP instances as one.
Do we need additional text how the display locates the various SOP instances?

Answer: The IHE Radiology Technical Committee decided to cover the 80 – 90% of situations where the study will be completed with one single scan and all frames will be stored in one object. Thus the issue of multiple objects (other than Concatenation) is
110 *out of scope in this profile.*

Volume 1 – Integration Profiles

115

Glossary

Add the following terms to the Glossary:

<any glossary additions associated with the profile draft go here>

1.7 History of Annual Changes

120 *<Brief overview of "what's new" in the given year of the Technical Framework.>*

Add the following bullet to the end of the bullet list in section 1.7

- Added the CT/MR Perfusion Imaging with Contrast Integration Profile.

2.1 Dependencies among Integration Profiles

Add the following row to Table 2-1

125

CT/MR Perfusion Imaging with Contrast	*none*	*none*	-

Add the following section to section 2.2

2.2.23 CT/MR Perfusion Imaging with Contrast Integration Profile

130 The CT/MR Perfusion Imaging with Contrast Integration Profile facilitates the exchange of contrast-enhanced images containing standard attributes for timing and position. The exchange of these attributes allows for correct and convenient display.

Add a column to table 2.3-1 and place PERF in the header and an X in rows:

Acq. Modality;

135 *Image Archive;*

Image Display;

Image Manager

140   *Add a column to table 2.3-2 and place PERF in the header and an X in rows:*

  Modality Images Stored [RAD-8]

  Storage Commitment [RAD-10]

  Query Images [RAD-14]

  Retrieve Images [RAD-16]

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Add Section X

25   CT/MR Perfusion Imaging with Contrast Integration Profile

CT/MR Perfusion Imaging with Contrast creates stacks of images at different timeslots, in order to demonstrate the uptake of a contrast agent over time.

150   This Integration Profile defines how these perfusion images are stored and archived into frames of one Enhanced DICOM (Multi-frame) object so that they can later be retrieved and displayed in an unambiguous way on image viewers supporting Enhanced DICOM objects.

This enables widespread and adequate review and interpretation of contrast-enhanced frames by radiologists in an IT environment where all Actors support the Enhanced CT or Enhanced MR

155   DICOM objects; mixed environments that would need conversion of Enhanced objects into single-frame objects are out of scope. This Profile does not cover workflow or post-processing capabilities.

25.1 Actors/Transactions

160   Figure 25.1-1 diagrams the actors involved with this profile and the transactions between actors.
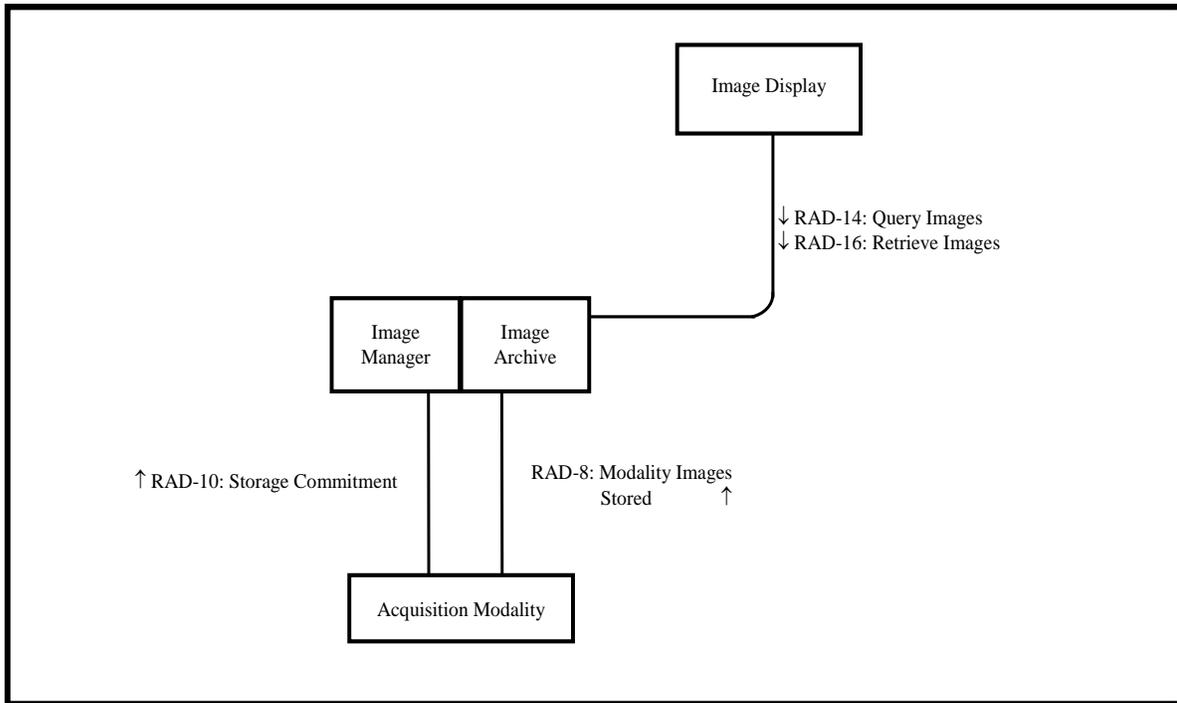
Figure 25.1-1. CT/MR Perfusion Imaging with Contrast Diagram

Table 25.1-1 lists the transactions for each actor directly involved in the CT/MR Perfusion
165 Imaging with Contrast Integration Profile. To claim support of this Integration Profile, an
implementation must perform the required transactions (labeled "R"). Transactions labeled "O"
are optional. A complete list of options defined by this Integration Profile and that
implementations may choose to support are listed in Section 25.2.

170 **Table 25.1-1. CT/MR Perfusion Imaging with Contrast - Actors and Transactions**

Actors	Transactions	Optionality	Section in Vol. 2
Acquisition Modality	Modality Images Stored [RAD-8]	R	4.8
	Storage Commitment [RAD-10]	R	4.10
Image Manager/Archive	Modality Images Stored [RAD-8]	R	4.8
	Creator Images Stored [RAD-18]	R	4.18
	Storage Commitment [RAD-10]	R	4.10
	Query Images [RAD-14]	R	4.14
	Retrieve Images [RAD-16]	R	4.16
Image Display	Query Images [RAD-14]	R	4.14
	Retrieve Images [RAD-16]	R	4.16

25.2 CT/MR Perfusion Imaging with Contrast Integration Profile Options

Options that may be selected for this Integration Profile are listed in the table 25.2-1 along with
175　the Actors to which they apply. Dependencies between options when applicable are specified in
notes.

Table 25.2-1. CT/MR Perfusion Imaging with Contrast – Actors and Options

Actor	Options	Vol & Section
Acquisition Modality	*No options defined*	-
Image Manager/ Image Archive	*No options defined*	-
Image Display	*No options defined*	-

25.3 CT/MR Perfusion Imaging with Contrast Process Flow

180　The typical use case is the acquisition of a complete series of images without the need to add
additional images later. This means that there are no re-takes or additional phases acquired after
the original set of images was created.

The Acquisition Modality stores the complete set of images as one single Enhanced DICOM
object to the Image Manager/ Archive so that it can be retrieved later for viewing and
185　interpretation.

This use case does not describe additional use of the newly acquired image set, e.g. how to
transfer or use it for quality assurance, post-processing or timely display at other workstations.
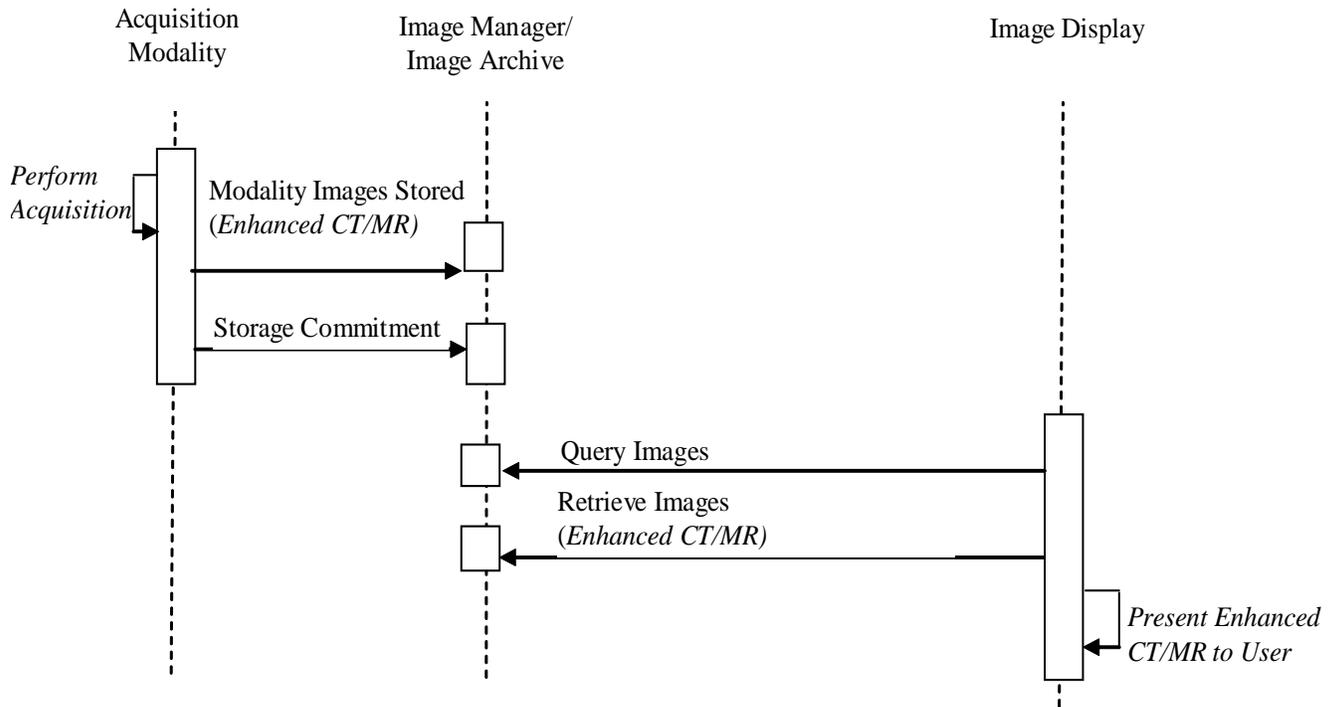
190

Figure 25.3-1. CT/MR Perfusion Imaging with Contrast Process Flow

Volume 2 - Transactions

Append section 4.8.4.1.2 with the following subsection and substitute .n with the appropriate serial number

195   *Note to the editor: The MR Diffusion Imaging supplement should be processed first!*

4.8.4.1.2.5.2 CT/MR Contrast Perfusion

Systems supporting the CT/MR Perfusion Imaging with Contrast Profile shall comply with the requirements in this section.

In the context of the CT/MR Perfusion Imaging with Contrast profile objects shall have Image
200   Type and Frame Type values as shown in table 4.8.4.1.2.5.2-1.

Table 4.8.4.1.2.5.2-1 Image Type and Frame Type values

	Image Type	Frame Type
Value 1	ORIGINAL	ORIGINAL
Value 3	PERFUSION	PERFUSION
Value 4	-	-

Note: value 2 is, by definition, always PRIMARY

In addition to the required attributes described in the DIFF supplement in section 4.8.4.1.2.5, the
205   attributes in table 4.8.4.1.2.5.2-2 shall also be supported.

Table 4.8.4.1.2.5.2-2 Enhanced CT/MR Object Attributes for Contrast Perfusion

Attribute Name	Tag	Requirement
Frame Content functional group macro		
Frame Content Sequence	(0020,9111)	
>Temporal Position Index	(0020,9128)	R+

The Dimension Index Pointer shall be populated with the:

210   1. Stack ID (0020,9056)

        2. In-Stack Position Number (0020,9057)

        3. Temporal Position Index (0020,9128)

All acquired contrast perfusion images shall be stored in a single Enhanced CT or Enhanced MR SOP Instance.

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Table 4.8-1. Suggested Image SOP Classes

SOP Class UID	SOP Class Name
…	
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.2.1	**Enhanced CT Image Storage**
1.2.840.10008.5.1.4.1.1.4	MR Image Storage
1.2.840.10008.5.1.4.1.1.4.1	Enhanced MR Image Storage
…	

220 Acquisition Modality actors claiming the CT/MR Perfusion Imaging with Contrast Profile are required to support at least one of the SOP classes listed in Table 4.8-6 below.

Image Manager/Image Archive actors claiming the CT/MR Perfusion Imaging with Contrast Profile are required to support both of the SOP classes listed in Table 4.8-6 below.

225 **Table 4.8-6. Contrast Perfusion**

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.4.1	Enhanced MR Image Storage
1.2.840.10008.5.1.4.1.1.2.1	Enhanced CT Image Storage

4.16.4.1.3.5 CT/MR Perfusion Imaging with Contrast Profile

230 Image Display and Image Manager/Image Archive actors that claim the CT/MR Perfusion Imaging with Contrast Profile shall support all the SOP Classes specified in Table 4.8-6 in section 4.8.

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4.16.4.2.2.7 Display of CT/MR Perfusion Imaging with Contrast objects

The contents of this section are required for Image Displays claiming the CT/MR Perfusion Imaging with Contrast Profile.

The following requirements are intended to establish a baseline level of capabilities.

240 In the case of a Concatenation for which there is more than one SOP Instance, all instances shall have an identical Concatenation UID (0020,9161). In this case the Image Display shall load all the SOP Instances of the Concatenation and treat them as one object.

The Image Display shall be capable of using the information from the Dimension Index Values (0020,9157) to separately display frames in different viewports.

245 In a single viewport in stack mode, the Image Display shall provide the user with a choice between ordering the frames to:

- Scroll by Temporal Position Index then Stack ID (0020,9128) / In-Stack Position Number (0020,9057).

- Scroll by Stack ID / In-Stack Position Number (0020,9057) then Temporal Position
250 Index (0020,9128).

The Image Display shall provide at least one viewport for displaying frames with the same In-Stack Position Number index. More viewports may be used for displaying frames with other In-Stack Position Number values.

Image Display actors supporting the CT/MR Perfusion Imaging with Contrast profile shall be
255 able to display all of the attributes listed in Table 4.16.4.2.2.7-1.

Table 4.16.4.2.2.7-1. Perfusion Display Attributes

Attribute Name	Tag
Enhanced Contrast/Bolus Module	
Contrast/Bolus Agent Sequence	(0018,0012)
>Contrast/Bolus Administration Route Sequence	(0018,0014)
Frame Type Value 3	(0008,9007)
Frame Content Sequence	(0020,9111)
>Temporal Position Index	(0020,9128)
>Stack ID	(0020,9056)
>InStackPositionNumber	(0020,9057)

This requirement is in addition to any display of slice offset in mm and frame number.

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