Digital Imaging and Communications in Medicine (DICOM)

Supplement 174: RESTful Rendering

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1 Scope and Field of Application

This supplement defines rendering functionality for Restful Services (RS) that is largely equivalent to the functionality in the URI and WS services. It defines Retrieve Rendered and Retrieve Rendered Presentation State transactions for Restful Services. These transactions allow a user agent to retrieve rendered images and other instances in non-DICOM media types from an origin server.

In response to a user agent's request, the origin server will render DICOM instances (images, video, reports, etc.) and encode them in consumer format media types. Almost all consumer formats require remapping the pixel depth to 8 bits.

Security is beyond the scope of the RESTful services defined in this supplement. However generic Web security mechanisms are fully compatible.

2 Normative References

Insert the following in Section 2 at the appropriate place:

[IEC 61966-2.1] IEC. 1999. *Multimedia systems and equipment - colour measurement and management - Part 2.1: colour management - Default RGB colour space – sRGB. ISBN: 2-8318-4989-6 - ICS codes: 33.160.60, 37.080 - TC 100 - 51 pp. as amended by Amendment A1:2003*. https://en.wikipedia.org/wiki/RGB_color_space

ISO/IEC 2022:1994 Information technology -- Character code structure and extension http://www.ecma-international.org/publications/standards/Ecma-035.htm

IETF RFC2046 Multipurpose Internet Mail Extensions (MIME) Part Two: Media Types https://tools.ietf.org/html/rfc2046

IETF RFC2387 The MIME Multipart/Related Content-type https://tools.ietf.org/html/rfc2387

IETF RFC2978 IANA Charset Registration Procedures https://tools.ietf.org/html/rfc2978

IETF RFC6838 Media Type Specifications and Registration https://tools.ietf.org/html/rfc6838

IETF RFC6365 Terminology Used in Internationalization in the IETF https://tools.ietf.org/html/rfc6365

IETF RFC7405 Case Sensitive Strings in ABNF https://tools.ietf.org/html/rfc7405

4 Terms and Definitions

Insert the following in Section 4 at the appropriate place:

Accept Query Parameter

A query parameter that specifies one or more media types acceptable for the representation(s) contained in the response. See Section 6.1.1.5.

Acceptable Character Sets

One or more character sets acceptable to the user agent in the response. See Section 6.1.2.1.

Acceptable Media Types

One or more media type acceptable to the user agent in the response. See Section 6.1.1.4.

Charset Query Parameter

A query parameter that specifies one or more character sets for the representation(s) contained in the response. See Section 6.1.2.2.

DICOM Resource Categories

A set of categories for the content of DICOM SOP Instances. Examples include images, video, and text. See Section 6.1.1.2.

Rendered Media Type

A non-DICOM media type into which DICOM instances may be transformed in order to display them using commonly available non-DICOM software, for example browsers. See Section 6.1.1.3.

Selected Character Set

The character sets selected by the origin server for the response payload. See Section 6.1.2.4.

Selected Media Type

The media type selected by the origin server for the response payload. See Section 6.1.1.7.

sRGB

A standard RGB color space <https://en.wikipedia.org/wiki/RGB_color_space> defined in [IEC 61966-2.1].

UTF-8

Unicode UTF-8 character set

6 Data Communication Requirements

Add a new Section 6.1.1:

6.1.1 Media Types

Media types are identifiers used to define the data format of a representation. HTTP uses media types in the Content-Type and Accept header fields in order to provide open and extensible data typing and type negotiation. The syntax of media types is:

```
media-type = type "/" subtype *(OWS ";" OWS parameter)
```

Where

```
type       = token
subtype    = token
parameter  = token "=" (token / quoted-string))
```

The <type>/<subtype> may be followed by parameters in the form of name=value pairs.

The type, subtype, and parameter name tokens are case-insensitive, but the case sensitivity of parameter values depends on the semantics of the parameter name. The presence or absence of a parameter might be significant to the processing of a media-type, depending on its definition within the media type registry.

A parameter value can be transmitted either as a token or quoted-string. The quoted and unquoted values are equivalent.

Media types are defined in [RFC7231, Section 3.1.1.1 <https://tools.ietf.org/html/rfc7231#section-3.1.1.1>].

IANA maintains a registry of media types at <http://www.iana.org/assignments/media-types/media-types.xhtml>.

6.1.1.1 Multipart Media Types

Some of the services defined in this Standard support the multipart media types [RFC2387 <https://tools.ietf.org/html/rfc2387>]. The syntax is:

```
multipart-media-type = "multipart" "/" subtype *( OWS ";" OWS parameter )
```

The "application/multipart-related" media type is used by the RS services. Its syntax is:

```
multipart-related = "multipart/related"
                    OWS ";" OWS "type" "=" DQUOTE media-type DQUOTE
                    OWS ";" OWS "boundary" "=" boundary
                   [related-parameters]
```

Where

```
boundary = 0*69bchar bchar-nospace
bchar = bchar-nospace / SP
bchar-nospace = DIGIT / ALPHA / "'" / "(" / ")" / "+" / "_" / "," / "-"
             / "." / "/" / ":" / "=" / "?" "/" / ":" / "=" / "?"
related-parameters  =  [";" "start" "=" cid]
                       [";" "start-info" "=" cid-list]
cid-list = cid cid-list
cid      = token / quoted-string
```

The "type" parameter is required. It contains the media type of the "root" body part. It always contains the special character "/" and thus requires quote marks.

The <cid> is a content identifier. It should be unique for each part of the multipart message.

Typically, the "start" and "start-info" parameters are not specified, and the "root" is the first body part.

6.1.1.2 DICOM Resource Categories

Table 6.1.1-1 defines Resource Categories that correspond to different SOP Classes. The following sections map each Resource Category to appropriate DICOM and Rendered media types.

Table 6.1.1-1: Resource Categories

Resource Category	Definition
Single Frame Image	This category includes all resources that: 1) are instances of a single frame SOP Class, or 2) are instances of a multi-frame SOP Class that contain only one frame, or 3) are a single frame selected from an instance of a multi-frame SOP Class.
Multi-Frame Image	This category includes all resources that are instances of a multi-frame SOP Class, that are not video and that contain more than one frame.
Video	This category includes all resources that contain more than one frame and: 1) are instances encoded in the MPEG family of transfer syntaxes (which includes MP4 and H265), or 2) are time based (motion) multi-frame images that the origin server is capable of encoding in the MPEG family.
Text	This category includes all resources that: 1) contain the SR Document Content Module (see PS3.4, Section C.17.3), such as narrative text, structured reports, CAD, measurement reports, and key object selection documents, or

	2) contain the Encapsulated Document Module (see PS3.4, Section C.24.2).
Other	This category includes all resources that are not included above.

6.1.1.3 Rendered Media Types

DICOM resources may be converted into non-DICOM media types in order to render them using commonly available non-DICOM software, such as browsers.

175 For example:

1. A DICOM SOP Instance containing an image could be rendered into the image/jpeg or image/png Rendered Media Types.
2. A DICOM SOP Instance containing a multi-frame image in a lossless transfer syntax could be rendered into a video/mpeg or video/mp4 Rendered Media Type.
180 3. A DICOM SOP Instance containing a Structured Report could be rendered into a text/html, text/plain, or application/pdf Rendered Media Type.

Note: Rendered Media Types are usually consumer format media types.

Table 6.1.1-2: Specifies the meaning of media type requirements in Table 6.1.1-3.

Table 6.1.1-2: Definition of Media Type Requirement

Requirement	Definition
default	The origin server shall support all default media types.
required	The origin server shall support these media types.
optional	The origin server may support these media types.

185 Table 6.1.1-3 defines the Rendered Media Types by their Resource Category for the URI, WS, and RS modes.

Table 6.1.1-3: Rendered Media Types by Resource Category

Category	Media Type	URI	WS	RS
Single Frame Image	image/jpeg	default	default[1]	default
	image/gif	optional	optional	required
	image/png	optional	optional	required
	image/jp2	optional	optional	optional
Multi-Frame Image	image/gif	optional	optional	optional
Video	video/mpeg	optional	optional	optional
	video/mp4	optional	optional	optional
	video/H265	optional	optional	optional
Text	text/html	default	default	default
	text/plain	required	required	required
	text/xml	optional	optional	required
	text/rtf	optional	optional	optional
	application/pdf	optional	optional	optional

When an image/jpeg media type is returned, the image shall be encoded using the JPEG baseline lossy 8 bit Huffman encoded non-hierarchical non-sequential process defined in ISO/IEC 10918-1.

190 Note

A DICOM encapsulated CDA resource may be returned as a text/xml media type.

The origin server may support additional rendered media types.

6.1.1.4 Acceptable Media Types

The term Acceptable Media Types denotes the media types that are acceptable to the user agent in the response. The Acceptable Media Types are those specified in:

- The <accept> query parameter, which may or may not be present.
- The Accept header field, which shall be present.
- The default media type for the target resource, if any.

All requests that expect a response with a payload, shall include the Accept header field. The response to a request without an Accept header field shall be 406 (Not Acceptable). Even if specific media types are provided in the <accept> query parameter, an Accept header field with one or more values shall be present, at a minimum */*.

The Acceptable Media Types shall be either DICOM media-types or Rendered media types, but not both. If the Acceptable Media Types contains both DICOM and Rendered Media Types, the origin server shall return 409 (Conflict).

The user agent may specify the relative degree of preference for media types, whether in the <accept> query parameter or the Accept header field, using the <weight> parameter. See [RFC7231, Section 5.3.1 <https://tools.ietf.org/html/rfc7231#section-5.3.1>].

```
weight = OWS ";" OWS "q=" qvalue
qvalue = ("0" ["." 0*3DIGIT]) / ("1" ["." 0*3("0")])
```

If no "q" parameter is present, the default qvalue is 1.

6.1.1.5 Accept Query Parameter

The <accept> query parameter is primarily designed for use in hyperlinks (URLs) embedded in documents, where the Accept header field is not accessible. It is similar to the Accept header field, except that it shall not have wildcards (<type>/* or */*).

The <accept> query parameter has the following syntax:

```
accept        = accept-name "=" 1#(media-type [weight])
accept-name   = "%s" quoted-string
```

Note

The "%s" that prefixes the <accept-name> specifies that it is a case sensitive token. See [RFC7405].

Its value is a comma-separated list of one or more <media-type>s, possibly including parameters. It shall be supported by the origin server. It is optional for the user agent.

The <accept-name> of the <accept> query parameter is defined by the Service. It is case-sensitive. Table 6.1.1-4 contains the <accept-name> of the <accept> query parameter for some services.

Table 6.1.1-4: <accept> Query Parameter Name by Service

Service	Name
URI	`accept-name = "contentType"`
WS	`not applicable`
RS	`accept-name = "accept"`

The <accept> query parameter should not be used when the user agent can specify the values in the Accept header field.

All media types present in an <accept> query parameter shall be compatible with a media range in the Accept header field, either explicitly or implicitly through wildcards.

Note:

For example, the presence of image/jpeg in the <accept> query parameter will require the Accept header field to include one of the following values: image/jpeg, image/*, or */*.

6.1.1.6 Accept Header Field

The Accept header field is used to specify media ranges acceptable to the user agent. It has the following syntax:

```
Accept = 1#(media-range [weight])
```

Where,

```
media-range = media-type
            / type "/" "*" parameters
            / "*/*" parameters
parameters ; See Section 6.1.1
```

The Accept header field shall be present. Its value shall be a comma-separated list of one or more media ranges acceptable in the response. See [RFC7231, Section 5.3.2 <https://tools.ietf.org/html/rfc7231#section-5.3.2>].

A media range is either a media-type or a wildcard. Wildcards use the asterisk ("*") to group media types into ranges, with <type>/* indicating all subtypes of that type, and */* indicating all media types from the target's Resource's Category.

For example, the media range "image/*" matches "image/jpeg", which is the default media type for the Single Frame Image Resource Category, and "text/*" matches "text/html", which is the default media type for the Text Resource Category. The "*/*" media range matches the default media type for the target's Resource Category.

If the origin server receives a request without an Accept header field, but that might have a response payload, it shall return a 406 (Not Acceptable).

6.1.1.7 Selected Media Type

The Selected Media Type is the media type selected by the origin server for the response payload. The media types in the <accept> query parameter and the media ranges in the Accept header field shall each be separately prioritized according to the rules defined in [RFC7231, Section 5.3.1].

The Selected Media Type is chosen as follows:

1. Select the target's Resource Category
2. Select the representation with the highest priority supported media type for that category in the <accept> query parameter, which is compatible with the Accept header field.
3. If no media type in the <accept> query parameter is supported, select the highest priority supported media type for that category in the Accept header field, if any.
4. Otherwise, select the default media type for the category if the Accept header field contains a wildcard media range matching the category, if any.
5. Otherwise, return a 406 (Not Acceptable).

For a set of media types in the <accept> query parameter (step 2 above), or for a set of media ranges in the Accept header field (step 3 above), the highest priority supported media type is determined as follows:

1. Assign a <qvalue> of 1 to any member of the set that does not have a one.
2. Assign each representation supported by the origin server the <qvalue> of the most specific media type that it matches.
3. Select the representation with the highest <qvalue>. If there is a tie, the origin server shall determine which is returned.

For example, consider an origin server which receives a request with the following Accept header field:

```
Accept: text/*; q=0.5, text/html; q=0.4, text/html; level=1, text/html; level=2; q=0.7,
        image/png, */*; q=0.4
```

Suppose that for the resource indicated in the request, the origin server supports representations for the following media types:

```
text/html (regular, level 1 and level 2)
text/rtf
text/plain
text/x-latex
```

These media types are assigned the following <qvalue>s, based on the media ranges above:

Media Type	qvalue	Determining Media Range
text/html; level=1	1.0	text/html; level=1
text/html; level=2	0.7	text/html; level=2
text/plain	0.5	text/*
text/rtf	0.5	text/*
text/html	0.4	text/html
text/x-latex	0.4	*/*

Although "image/png" has been assigned a default <qvalue> of 1.0, it is not among the supported media types for this resource, and thus is not listed.

The selected media type is "text/html; level=1" since it is the supported media type in the Text Category with the highest qvalue.

6.1.2 Character Sets

HTTP uses charset names to indicate or negotiate the character encoding of textual content in representations [RFC6365, Section 3.3 <https://tools.ietf.org/html/rfc6365#section-3.3>].

Character sets may be identified using the value in the IANA Preferred MIME Name column in the IANA Character Set Registry <http://www.iana.org/assignments/character-sets/character-sets.xhtml>.

Character sets may be identified by using the DICOM Defined Terms for the character set. See PS3.3, Section C.12.1.1.2, and PS3.5, Section 6.1.2.3.

The origin server shall support the "UTF-8" charset name for RS Retrieve Rendered, but is not required to support the DICOM Defined Term "ISO_IR 192".

The syntax is:

```
charset = token / defined-term / DQUOTE defined-term DQUOTE
```

Where

token — A case-insensitive charset name from the Preferred MIME Name in the IANA Character Set Registry.

defined-term — See PS3.3, Section C.12.1.1.2.

Some DICOM Defined Terms for character sets contain space characters; and shall be enclosed in double quotes in HTTP header fields and percent encoded in URLs.

The Conformance Statement shall document all supported character sets. The Retrieve Capabilities response for all RS Services shall also document all supported character sets.

A request without any <charset> query parameter or Accept-Charset header field implies that the user agent will accept any charset in the response.

Annex D contains a mapping of some Specific Character Set (0008,0005) Defined Terms to IANA charset tokens.

6.1.2.1 Acceptable Character Sets

The term Acceptable Character Sets denotes the character sets that are acceptable to the user agent in the response. The Acceptable Character Sets are those specified in:

- the "charset" media type parameter
- the <character-set> query parameter
- the Accept-Charset header field
- the default character set for the media type, if any

When the acceptable character sets contains a list of one or more Defined Terms they should be ordered as specified in PS3.3, Section C.12.1.1.2, and PS3.5, Section 6.1.2.3. This is especially important for ISO 2022 character sets.

6.1.2.2 Character Set Query Parameter

The <character-set> query parameter is primarily designed for use in hyperlinks (URLs) embedded in documents, where the Accept-Charset header field is not accessible.

The <character-set> query parameter has the following syntax:

```
character-set = name "=" 1#(charset [weight])
```

The <character-set> query parameter value is a comma-separated list of one or more <charset>s. It is similar to the Accept-Charset header field, except that it shall not have wildcards. It shall be supported by the origin server. It is optional for the user agent.

All <charset>s present in the <character-set> query parameter may have a corresponding character set in the Accept-Charset header field, either explicitly or implicitly through wildcards.

The <name> of the <character-set> query parameter is defined by the Service. Table 6.1.2-1 contains the names of the <character-set> query parameter for some services.

Table 6.1.2-1: <character-set> Query Parameter Name by Service

Service	Name
URI	`name = "charset"`
WS	`not applicable`
RS Studies	`name = "charset"`

6.1.2.3 Accept-Charset Header Field

The Accept-Charset header field has the following syntax:

```
Accept-Charset = 1#(charset [weight]) / ("*" [weight])
```

The user agent may provide a list of Acceptable Character Sets in the Accept-Charset header field of the request. Its value is a comma-separated list of one or more <charset>s and/or the wildcard value ("*"). It shall be supported by the origin server. It is optional for the user agent.

The values of the Accept-Charset header field values are prioritized by their <weight> parameter.

If no wildcard ("*") is present, then any character sets not explicitly mentioned in the header field are considered "not acceptable" to the client.

A request without an Accept-Charset header field implies that the user agent will accept any charset in response.

If the media type defines a "charset" parameter, it should be included with the media type in the Accept header field, rather than in the Accept-Charset header field.

6.1.2.4 Selected Character Set

The origin server shall determine the Selected Character Set(s) as follows:

1. Select the first supported character set in the "charset" parameter(s) of the Selected Media Type.
2. Otherwise, select the highest priority supported <charset> in the <character-set> query parameter.
3. Otherwise, select the highest priority supported <charset> in the Accept-Charset header field.
4. Otherwise, if the Selected Media Type has a default character set that is supported, select it.
5. Otherwise, select UTF-8.

Rendered representations returned in the response shall have all contained strings returned in the Selected Character Sets.

If the character set in which the target resource is encoded is not the Selected Character Set:

- If the origin server supports transcoding all glyphs used in the target resource into the Selected Character Set, it shall transcode the response payload into the Selected Character Set
- Otherwise, the origin server shall return 406 (Not Acceptable).

Note

This means that some SOP Instances may be convertible and others will not be, even though they have the same Specific Character Set (0008,0005).

All origin servers shall support conversion to the UTF-8 character set for RS Rendered Retrieve.

If the user agent chooses to perform its own conversion rather than have it done by the origin server:

1. The user agent may omit the Accept-Charset header field or send the "*" wildcard
2. The user agent may transcode the character set replacing all unknown characters with a suitable replacement. For example:
   - A question mark ("?"), or other similar character indicating an unknown character.
   - The corresponding Unicode Code Point for the character, represented as "U+xxxx".
   - The four characters "\nnn", where "nnn" is the 3 digit octal representation of each byte (see PS3.5, 6.1.2.3).

Update Section 6.2.2 as follows:

6.2.2 ~~List of~~ Media Types ~~Supported~~ Acceptable in the Response

~~**The "Accept" field of the GET method request shall specify the Media type(s) acceptable to the Web Client System. The(se) Media type(s) shall include at least the items of the list of MIME types specified in Section 7 of this standard devoted to the DICOM persistent object types.**~~

~~**Note**~~

~~**Typically the Accept field will be sent by a Web Client as "*/*". An optional parameter specifies the MIME type(s) preferred by the Web Client, as a subset of those specified in the "Accept" field.**~~

6.2.2.1 Query Parameters

6.2.2.1.1 Accept Query Parameter

Specifies the Acceptable Media Types for the response payload. See Section 6.1.1.4. The name of the parameter is "contentType", which is case-sensitive. Its syntax is:

```
accept = %s"contentType" "=" 1#media-type
```

6.2.2.1.2 Character Set Query Parameter

Specifies the Acceptable Character Sets for the response payload. See Section 6.1.2.1. The name of the parameter is "charset", which is case-sensitive. Its syntax is:

```
character-set = %s"charset" "=" 1#(token / [DQUOTE defined-term DQUOTE])
```

6.2.2.2 Header Fields

6.2.2.2.1 Accept

The Accept header field specifies the media type(s) acceptable to the user agent in the response. It shall be present. See Section 6.1.1.6 for details.

6.2.2.2.2 Accept-Charset

The Accept-Charset header field specifies the character set(s) acceptable to the user agent in the response. It is optional. See Section 6.1.2.3 for details.

Update Section 6.5 as follows:

6.5 WADO-RS Request/Response

The DICOM RESTful Service defines several action types. An implementation shall support all the following six action types:

1. RetrieveStudy

   This action retrieves the set of DICOM instances associated with a given study unique identifier (UID). The response can be DICOM or bulk data depending on the "Accept" type, and is encapsulated in a multipart MIME response.

2. RetrieveSeries

   This action retrieves the set of DICOM instances associated with a given study and series UID. The response can be DICOM or bulk data depending on the "Accept" type, and is encapsulated in a multipart MIME response.

3. RetrieveInstance

   This action retrieves the DICOM instance associated with the given study, series, and SOP Instance UID. The response can be DICOM or bulk data depending on the "Accept" type, and is encapsulated in a multipart MIME response.

4. RetrieveFrames

   This action retrieves the DICOM frames for a given study, series, SOP Instance UID, and frame numbers. The response is pixel data, and encapsulated in a multipart MIME response.

5. RetrieveBulkdata

   This action retrieves the bulk data for a given bulk data URL. The response is a single bulk data item.

6. RetrieveMetadata

   This action retrieves the DICOM instances presented as the study, series, or instance metadata with the bulk data removed.

WADO-RS requests may contain the following query parameters:

"accept" The <accept> query parameter is specified in Section 6.1.1.5. The syntax is:

```
accept = "accept=" 1#media-type
```

"charset" The <character-set> query parameter is specified in Section 6.1.2.2. The syntax is:

```
character-set = "charset" = 1#charset
```

WADO-RS requests shall include an "Accept" header field (see Section 6.1.1.6) specifying the Acceptable Media Types.

WADO-RS requests may optionally support the "Accept-Charset" header field. See Section 6.1.2.3.

DICOM objects returned shall be PS3.10 binary objects encoded in a requested Transfer Syntax (Explicit VR Little Endian by default) with one message part per DICOM Instance.

…

Insert the following at the end of 6.5.7:

6.5.8 RS Retrieve Rendered Transaction

The Retrieve Rendered transaction retrieves DICOM instances rendered as: images, text-based documents, or other appropriate representations depending on the target resource. Its primary use case is to provide user agents with a simple interface for displaying medical images and related documents, without requiring deep knowledge of DICOM data structures and encodings. It is similar to the Retrieve DICOM service in that it uses the same method, resources, header fields and status codes. The primarily difference is the query parameters and media types supported.

The origin server shall document the Composite SOP classes that it supports for this transaction in the Conformance Statement and in the response to the Retrieve Capabilities request, and shall be able to render all valid instances for which conformance is claimed, e.g., all photometric interpretations that are defined in the IOD for the SOP class.

If the origin server supports this transaction, it shall also support the Retrieve DICOM transaction (WADO-RS).

6.5.8.1 Request

The Retrieve Rendered service has the following request message syntax:

```
GET SP /{+resource}{?parameter*} SP version CRLF
Accept: 1#rendered-media-type CRLF
*(header-field CRLF)
CRLF
```

Where

`{+resource}`	References a non-Presentation State resource.
`{?parameter*}`	Zero or more query parameters as defined in Section 6.5.8.1.2.
`version`	HTTP version = "HTTP/1.1"
`1#rendered-media-type`	One or more Rendered Media Types See Section 6.1.1.3.

6.5.8.1.1 Target Resources

Table 6.5.8-1 shows the resources supported by the Retrieve Rendered transaction along with their associated URI templates.

Table 6.5.8-1: Resources, Templates, and Description

Target Resource	Resource URI Template
Study	/studies/{study_uid} Retrieves a study in acceptable Rendered Media Types.
Series	/studies/{study_uid}/series/{series_uid}

	Retrieves a series in an acceptable Rendered Media Type.
Instance	/studies/{study_uid}/series/{series_uid}/instances/{instance_uid} Retrieves an instance in an acceptable Rendered Media Type.
Frames	/studies/{study_uid}/series/{series_uid}/instances/{instance_uid}/frames/{frame_list} Retrieves one or more frames in an acceptable rendered media type.

6.5.8.1.2 Query Parameters

The query parameters defined in this section specify various rendering transformations to be applied to the images and video contained in the target resource.

The origin server shall support all of the query parameters defined in this section. An origin server may define additional parameters. If additional parameters are defined, they shall be documented in the Conformance Statement and in the Retrieve Capabilities response. The origin server shall ignore any unknown parameters.

The following rules pertain to all parameters defined in this section:

1. All parameters are optional for the user agent.
2. All parameters are required to be supported by the origin server.
3. These parameters only apply to resources that are images and video.
4. Instances that are not images will be rendered in an Acceptable Media Type, if one exists; otherwise, they will not be rendered.
5. The set of transformations specified by the parameters in this section shall be applied to the images as if they were a Presentation State, that-is, in the order specified by the applicable image rendering pipeline specified in PS 3.4.

Table 6.5.8-2: Retrieve Rendered Query Parameters

Key	Values	Target Resource	Section
annotation	"patient" and/or "procedure"	All	6.5.8.1.1.1
charset	token	All	6.1.2.2
quality	integer	All	6.5.8.1.1.2
viewport	vw, vh, [sx, sy, sw, sh]	Non-Presentation States	6.5.8.1.1.3
viewport	vw, vh,	Presentation States	6.5.8.1.1.3
window	center, width, shape	Non-Presentation States	6.5.8.2.1.2.2

6.5.8.1.2.1 Image Annotation

The annotation parameter specifies that the rendered images shall be annotated with patient and/or procedure information. Its value is a comma-separated list of one or more keywords. It has the following syntax:

```
%s"annotation=" 1#( %s"patient" / %s"technique" )
```

Where

`"patient"` Indicates that the rendered images shall be annotated with patient information (e.g., patient name, birth date, etc.).

`"technique"` Indicates that the rendered images shall be annotated with information about the procedure that was performed (e.g., image number, study date, image position, etc.).

When this parameter is not present, no annotations shall be applied.

The origin server shall apply the annotations after all other parameters have been applied.

The origin server may support additional keywords, which should be included in the Conformance Statement and the Retrieve Capabilities response.

Note

1. The exact nature and presentation of the annotation is determined by the origin server. The annotation is burned into the rendered image pixels.

2. A user agent wanting more control over annotations may retrieve an image, omitting the "annotation" parameter; and separately retrieve the metadata; and create customized annotations on the image.

6.5.8.1.2.2 Image Quality

The "quality" parameter specifies the requested quality of the rendered images. It has the following syntax:

```
%s"quality=" integer
```

Where

`integer` is an unsigned integer between 1 and 100 inclusive, with 100 being the best quality.

The "quality" parameter is only supported for media types that allow lossy compression.

Note:

1. Decompression and re-compression may degrade the image quality if the original image was already irreversibly compressed. If the image has been already lossy compressed using the same format as required (e.g., jpeg), it may be sent as it is without decompressing and re-compressing it.

2. The specific interpretation of the meaning of this parameter is determined by the origin server.

6.5.8.1.2.3 Scaling a Region of a Source Image(s) to a Viewport

The "viewport" parameter specifies a rectangular region of the source image(s) to be cropped, and a rectangular region corresponding to the size of the user agent's viewport to which the cropped image should be scaled.

If the target resource is a Presentation State Instance, the syntax for this parameter is:

```
%s"viewport=" vw "," vh
```

Otherwise it is:

```
%s"viewport=" vw "," vh [ "," [sx] "," [sy] "," [sw] "," [sh] ]
```

Where

`vw` and `vh` Are positive integers specifing the width and height, in pixels, of the rendered image.

`sx` and `sy` Are decimal numbers whose absolute values specify, in pixels, the top-left corner of the region of the source image(s) to be rendered. If either <sx> or <sy> is not specified it defaults to 0.

`sw` and `sh` Are decimal numbers whose absolute values specify, in pixels, the width and height of the region of the source image(s) to be rendered. If <sw> is not specified, the origin server shall render to the right edge of the source image. If <sh> is not specified, the origin server shall render to the bottom edge of the source image. If <sw> is a negative value, the image is flipped horizontally. If <sh> is a negative value, the image is flipped vertically.

The source image region parameters (sx, sy, sw, and sh) shall not be present when rendering a Presentation State Instance. If they are present the origin server shall return a 409 (Conflict).

The origin server shall first crop, if specified, then scale the source images, maintaining their original aspect ratio, until either the rendered image width is the same as the viewport width or the image height is the same as the viewport height, whichever avoids truncation. In other words, viewport scaling makes the

image(s) as large as possible, within the viewport, without overflowing the viewport area and without distorting the image.

If any of the optional parameter values are not present the default value shall be used. Individual values may be elided, but the commas between the values shall be present. For example:

```
viewport=512,512,,,512,512
```

The missing <sx> and <sy> parameter values shall default to 0.

If trailing values are elided, then the trailing commas shall be omitted. For example:

```
viewport=1024,1024
```

The missing <sx>, <sy>, <sw>, <sh> will have their default values, which means the image(s) will not be cropped, and the full image will be rendered.

If the viewport parameter is not present, the rendered image(s) shall not be scaled, i.e., the rendered image(s) shall contain the same sized pixel matrix as the source DICOM image.

Note

The default values for <sx> and <sy> differ from the defaults in the Specified Displayed Area in Presentation States, which uses integer values with the top left corner being (1,1). See PS3.3 Section C.10.4.

6.5.8.1.2.4 Windowing

The "window" parameter controls the windowing of the images as defined in PS3.3 Section C.8.11.3.1.5. It has the following syntax:

```
%s"window=" center "," width "," function
```

Where

`center`	is a decimal number containing the window-center value
`width`	is a decimal number containing the window-width value
`function`	is one of the following keywords: "linear", "linear-exact", or "sigmoid".

Note:

These correspond to the differently capitalized and punctuated values of VOI LUT Function (0028,1056). See PS3.3 Section C.11.2.1.2.

All three parameter values are required.

If the target resource is a Presentation State, this parameter shall not be used. If this parameter is present when the target resource is a Presentation state, the origin server shall return a 409 (Conflict).

6.5.8.1.3 Header Fields

Required: `Accept`

The values of the Accept header field shall be one or more Rendered Media Types.

6.5.8.1.4 Payload

This request has no payload.

6.5.8.2 Behavior

The target resource(s) are rendered according to the query parameters, by applying the transformations according to the appropriate rendering pipeline specified in PS3.4, Section N.2.

It the target resource is not a single instance, Presentation State Instances contained in the target resource shall not be rendered.

Rendered images shall contain no more than 8 bits per channel.

6.5.8.2.1 Presentation State Instance

If the target resource is a Presentation State Instance, that instance may contain references to one or more series, each of which may contain one or more instances, each of which may contain one or more frames. The response shall return rendered versions of all supported Instances and frames referenced by the Presentation State Instance.

For example, if the Presentation State instance references a multi-frame image, then the response will contain all frames specified by the target resource, or if the Presentation State instance references a series, then the response will contain all instances contained in that series.

If the Presentation State Instance contains a Blending Sequence, then the rendered images in the response shall correspond to the frames of the input that have a Blending Sequence Item with a Blending Position (0070,0405) value of UNDERLYING. See PS3.3, Section C.11.14.1.1.

The origin server shall render all of the images referenced by the Presentation State in an Acceptable Media Type using the rendering pipeline specified in PS3.4.

If there is more than one image in the response they shall be ordered according to the:

1. Dimension Index Values (0020,9157) attribute, if present
2. Image Position (Patient) (0020,0032) attribute, if present
3. Image Position Volume (0020,9301), if present
4. Order of the instance references in the presentation state

If the above does not fully specify the ordering of the frames, then the origin server shall resolve any remaining ambiguity in the ordering.

If the Presentation Size Mode is TRUE SIZE it shall be treated as SCALE TO FIT.

If the Presentation Size Mode is SCALE TO FIT, the origin server shall scale the Specified Displayed Area in the Presentation State, maintaining its original aspect ratio, until either the rendered image width is the same as the viewport width or the rendered image height is the same as the viewport height, whichever comes first. In other words, viewport scaling makes the displayed area selection as large as possible, within the viewport, without overflowing the viewport area and without distorting the image. If the viewport parameter is not present, the returned images shall have the dimensions of the Specified Displayed Area.

If the Presentation Size Mode is MAGNIFY, then the referenced images shall be scaled to the Specified Displayed Area in the Presentation State, and then they shall be cropped to the size specified by the "viewport" parameter. If the request does not contain a "viewport" parameter, then the referenced images shall not be cropped.

Any Specified Displayed Area relative annotations in the Presentation State shall be rendered relative to the Specified Displayed Area within the Presentation State, not the size of the viewport.

Though the output of the Presentation State is defined in DICOM to be in P-Values (grayscale values intended for display on a device calibrated to the DICOM Grayscale Standard Display Function PS3.14), the grayscale or color space for the rendered images is not defined by this standard.

6.5.8.3 Response

The Retrieve Rendered service has the following response message syntax:

```
version SP status-code SP reason-phrase CRLF
Content-Type: rendered-media-type CRLF
*(header-field CRLF)
CRLF
```

```
payload
```

Where

`version`	`the` HTTP version, for example "HTTP/1.1"
`rendered-media-type`	a Rendered Media Type. See Section 6.1.1.3.
`payload`	one or more representations in a Rendered Media Type.

6.5.8.3.1 Status Codes

The response shall include a status code from Table 6.5.8-3, if applicable; otherwise, an appropriate status code shall be used.

Table 6.5.8-3: Common Status Codes

Status Code	Meaning
200 Success	The origin server successfully rendered and is returning representations for the resource.
206 Partial Content	The origin server successfully rendered and is returning representations for part, but not all, of the resource.
406 Not Acceptable	The origin server does not support any of the Acceptable Media Types.
413 Payload Too Large	The target resource is too large to be rendered by the origin server.

6.5.8.3.2 Header Fields

Required: `Content-Type`

The value of the Content-Type header field shall be a Rendered Media Type.

6.5.8.3.3 Payload

The origin server shall include all successfully rendered representations in the payload.

Rendered images that do not contain a color management profile (e.g., an ICC profile), shall be assumed to be in sRGB space.

6.5.8.4 Media Types

The origin server shall be capable of returning representations in Rendered Media Types identified as default and required in Section 6.1.1.3.

Retire Section 7 of PS3.18. Replace with the following text:

Retired. See Section 6.1.1.

Update PS3.18, Section 8.1.5 as follows:

8.1.5 ~~MIME~~ Acceptable Media Types of the Response

~~**MIME type(s) desired by the Web Client for the response from the Server, as defined in the IETF RFC7230. This parameter is OPTIONAL for URI based mode, it shall be present for the WS mode "Rendered Requester" and shall not be present in the other WS mode transactions.**~~

This parameter contains one or more Acceptable Media Types as defined in Section 6.1.1.4. This parameter is OPTIONAL for URI mode. It shall be present for the WS mode "Rendered Requester" action, and shall not be present in the other WS mode transactions.

~~**The parameter name shall be "contentType" for URI based mode, and, for the WS mode, "ContentTypeList" that contains one or multiple "ContentType".**~~

In URI mode the parameter name shall be "contentType", and its value shall contain one or more media types.

In WS mode the parameter name shall be "ContentTypeList", which shall contain one or more "ContentType" elements, each containing a media type.

See Section 6.1.1 for details.

~~**In URI based mode, the value shall be a list of MIME types, separated by a "," character, and potentially associated with relative degree of preference, as specified in IETF RFC7230. In WS mode, it contains one or more "ContentType" elements containing each one MIME type.**~~

~~**In URI based mode, the Web Client shall provide list of content types it supports in the "Accept" field of the GET method. The value of the contentType parameter of the request shall be one of the values specified in that field.**~~

~~**Note**~~

~~**1. Typically the Accept field will be sent by a Web Client as "*/*", which is compatible with any MIME types.**~~

~~**2. When this parameter is absent, the default content type of the response is dictated by the "MIME type constraints" sub-sections of Section 7 (i.e., 7.1.2, 7.2.2, 7.3.2, 7.4.2).**~~

Update PS3.18, Section 8.1.6 with the following:

8.1.6 Charset of the Response

Character set with which the returned objects are to be encoded, as defined in the IETF RFC7230. This parameter is OPTIONAL for URI based mode, and for the WS mode "Rendered Requester" and shall not be present in the other WS mode transactions.

The parameter name shall be "charset" for URI ~~**based**~~ mode, and "CharsetList" containing one or more **"Charset"** elements ~~**"Charset"**~~ for ~~**the**~~ WS mode.

See Section 6.1.2 for details.

~~**For the URI mode, the value shall be a list of character sets, separated by a "," character, and potentially associated with relative degree of preference, as specified in IETF RFC7230.**~~

~~**In URI based mode, the Web Client may provide a list of character sets it supports in the "Accept-charset" field of the GET method. If this field is present, the value of the charset parameter of the request shall be one of the values specified in it.**~~

~~**The Web Server may or may not support character set conversion. If character set conversion is supported:**~~

~~**• text based DICOM objects retrieved other than as application/dicom MIME type (e.g., text/plain) may be returned in the requested character set (converted if necessary)**~~

~~**• DICOM objects retrieved as application/dicom MIME type have all contained strings returned in the requested character set (converted if necessary) and the Specific Character Set (0008,0005) updated (if necessary)**~~

~~**Note**~~

~~**1. The IANA Character Set registrations specify names and multiple aliases for most character sets. The standard value for use in WADO is the one marked by IANA as "preferred for MIME." If IANA has not marked one of the aliases as "preferred for MIME", the name used in DICOM shall be the value used for WADO.**~~

~~2. The table in Annex D provides an informative mapping of some IANA values to DICOM Specific Character Set Defined Terms.~~

Update Annex D as follows:

Annex D IANA Character Set Mapping ~~(Informative)~~

~~The following table provides an informative mapping of some IANA values to DICOM Specific Character Set Defined Terms:~~

Table D-1 provides a mapping of some IANA Character Set Registry < http://www.iana.org/assignments/character-sets/character-sets.xhtml> Preferred MIME Names to DICOM Specific Character Set Defined Terms.

Table D-1. IANA Character Set Mapping

IANA Preferred MIME Names	DICOM Defined Terms for Specific Character Set (0008,0005)	Language(s)
ISO-8859-1	ISO_IR 100	Latin-1 Latin alphabet #1
ISO-8859-2	ISO_IR 101	Latin-2 Eastern European
ISO-8859-3	ISO_IR 109	Latin alphabet #3
ISO-8859-4	ISO_IR 110	Latin alphabet #4
ISO-8859-5	ISO_IR 144	Cyrillic
ISO-8859-6	ISO_IR 127	Arabic
ISO-8859-7	ISO_IR 126	Greek
ISO-8859-8	ISO_IR 138	Hebrew
ISO-8859-9	ISO_IR 148	Latin alphabet #5
TIS-620	ISO_IR 166	Thai
ISO-2022-JP	**ISO 2022 IR 13**\ISO 2022 IR 87	Japanese
ISO-2022-KR	**ISO 2022 IR 6**\ISO 2022 IR 149	Korean
ISO-2022-CN	**ISO 2022 IR 6**\ISO 2022 IR 58	Chinese
GB18030	GB18030	Chinese
GBK	GBK	Chinese
UTF-8	ISO_IR 192	Unicode