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Digital Imaging and Communications in Medicine (DICOM)

Part 18: Web Access to DICOM Persistent Objects (WADO)

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- Standard -

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FOREWORD

This part of the DICOM standard was developed jointly with ISO TC 215 and is published by both organizations.

The text is identical to that published by ISO as ISO DIS 17432, though reformatted according to DICOM conventions.

The DICOM Standard is structured as a multi-part document using the guidelines established in the following document:

-ISO/IEC Directives, 1989 Part 3: Drafting and Presentation of International Standards.

This document is one part of the DICOM Standard that consists of the following parts:

PS 3.1: Introduction and Overview

PS 3.2: Conformance

PS 3.3: Information Object Definitions

PS 3.4: Service Class Specifications

PS 3.5: Data Structures and Encoding

PS 3.6: Data Dictionary

PS 3.7: Message Exchange

PS 3.8: Network Communication Support for Message Exchange

PS 3.9: Retired

PS 3.10: Media Storage and File Format

PS 3.11: Media Storage Application Profiles

PS 3.12: Media Format and Physical Media for Media Interchange

PS 3.13: Retired

PS 3.14: Grayscale Standard Display Function

PS 3.15: Security and System Management Profiles

PS 3.16: Content Mapping Resource

PS 3.17: Explanatory Information

PS 3.18: Web Access to DICOM Persistent Objects (WADO)

These parts are related but independent documents. Their development level and approval status may differ. Additional parts may be added to this multi-part standard. Part PS 3.1 should be used as the base reference for the current parts of this Standard.

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1 Scope

This standard specifies a web-based service for accessing and presenting DICOM (Digital Imaging and Communications in Medicine) persistent objects (e.g. images, medical imaging reports). This is intended for distribution of results and images to healthcare professionals. It provides a simple mechanism for accessing a DICOM persistent object from HTML pages or XML documents, through HTTP/HTTPs protocol, using DICOM UIDs (Unique Identifiers). Data may be retrieved either in a presentation-ready form as specified by the requester (e.g. JPEG or GIF) or in a native DICOM format. It does not support facilities for web searching of DICOM images. This standard relates only to DICOM persistent objects (not to other DICOM objects or to non-DICOM objects). Access control beyond the security mechanisms generally available to web applications is outside the scope of this standard.

2 Conformance

Systems claiming conformance to this standard shall function in accordance with all its mandatory sections.

3 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this part of DICOM. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of DICOM are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

HL7 CDA	Health Level Seven, Clinical Document Architecture (CDA)
IETF RFC2045 and followings	MIME Multipurpose Internet Mail Extension
IETF RFC2396	Uniform Resource Identifiers (URI): Generic Syntax
IETF RFC2616	Hypertext Transfer Protocol -- HTTP/1.1
IETF RFC3240	Application/dicom MIME Sub-type Registration
ISO/IEC 10918	JPEG Standard for digital compression and encoding of continuous-tone still images

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4 Terms and definitions

For the purposes of this part of DICOM, the following terms and definitions apply.

4.1 DICOM PERSISTENT OBJECT

An instance of a data object as defined by PS 3.3 that has been allocated an unique identifier in the format specified for SOP Instance UID in PS 3.3 and has been chosen as an object to be saved securely for some period of time. Within the DICOM Standard, a DICOM Persistent Object is referred to as a Composite Service Object Pair (SOP) Instance.

4.2 WEB CLIENT SYSTEM

A system using Internet technologies (web, e-mail…) interested in retrieving DICOM Persistent Objects from a Web Enabled DICOM Server, through HTTP/HTTPs protocol.

4.3 WEB ENABLED DICOM SERVER

A system managing DICOM Persistent Objects and able to transmit them on request to the Web Client System.

4.4 WEB ACCESS TO DICOM PERSISTENT OBJECTS

A service enabling the Web Client System to retrieve DICOM Persistent Objects managed by a Web Enabled DICOM Server, through HTTP/HTTPs protocol.

5 Symbols and abbreviated terms

DICOM Digital Imaging and Communications in Medicine

HL7 Health Level Seven

HTML HyperText Markup Language

HTTP HyperText Transfer Protocol

HTTPs HyperText Transfer Protocol, secured

MIME Multipurpose Internet Mail Extensions

SOP Service Object Pair

UID Unique (DICOM) Identifier

URL/URI Uniform Resource Locator / Identifier

XML eXtensible Markup Language

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6 Data Communication Requirements

6.1 INTERACTION

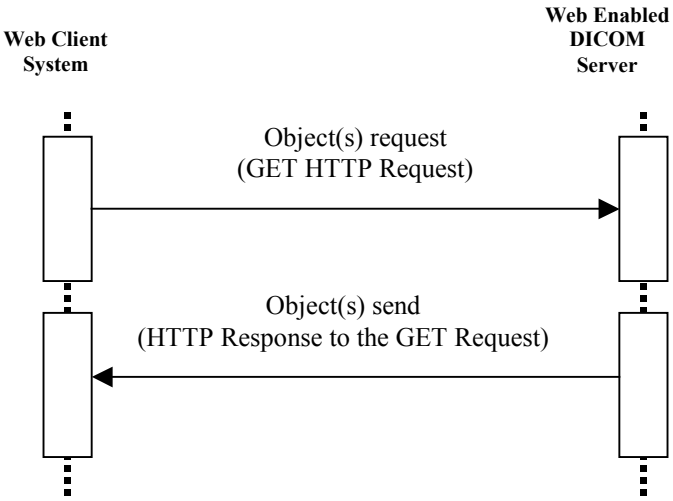

Figure 6-1 — Interaction Diagram

The interaction shall be as shown in Figure 6-1.

6.2 HTTP REQUEST

The HTTP Request used shall use the GET method as defined in IETF RFC2616.

6.2.1 Parameters of the HTTP Request

The parameters of the <query> component of the Request-URI to be sent to the web Server through the HTTP GET method request shall be represented as defined in IETF RFC2396.

Notes: 1. Other components of the Request-URI depend on the configuration, e.g. location and script language of the Web Enabled DICOM Server.

2. The means by which the Web Client System obtains the value of the necessary parameters for web accessing of DICOM objects is out of the scope of the standard.

6.2.2 List of Media types supported 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.

6.2.3 List of character sets supported in the Response

The "Accept-charset" field of the GET method request shall specify the character set of the object to be retrieved. If the "Accept-charset" field of the GET method is not present, or the Web Enabled DICOM Server does not support the specified character set, the character set of the response will be at the discretion of the Web Enabled DICOM Server.

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Note Typically the user of a Web Client does not have control over the “Accept-charset” field. An optional parameter specifies the character set to be used in the returned object.

6.3 HTTP RESPONSE

The response shall be an HTTP Response Message as specified in IETF RFC2616.

Note: The content of the message-body varies according to the Media type as defined below.

6.3.1 Body of single DICOM MIME sub-type part response

6.3.1.1 MIME Type

The MIME type shall be ‘application/dicom‘, as specified in IETF RFC3240.

6.3.1.2 Content

The body content shall be a "Part 10 File" that includes a meta-header as defined in PS 3.10.

6.3.1.3 Transfer syntax

The returned DICOM object shall be encoded using one of the transfer syntaxes specified in the transfer syntax query parameter as defined in Section 8.2.11 below. By default, the transfer syntax shall be "Explicit VR Little Endian".

Note: This implies that retrieved images are sent un-compressed by default.

6.3.2 Body of Non–DICOM MIME type response

6.3.2.1 MIME Type

The MIME type shall be one on the MIME types defined in the contentType parameter, preferably the most desired by the Web Client, and shall be in any case compatible with the ‘Accept’ field of the GET method.

Note: The HTTP behavior is that an error (406 – Not Acceptable) is returned if the required content type cannot be served.

6.3.2.2 Content

The content shall be a single MIME part containing the object to be retrieved.

Note: Multiple objects in a response are not supported by this standard. The parameters select only a single object to retrieve. Most current Web Clients are able to retrieve single objects, within a "non multipart" MIME body, and are not able to support multipart/related or multipart/mixed responses.

7 Persistent Object types

The provisions for some specific object types shall be as defined in this section.

Note: In all cases the categorization depends on the SOP Class of the objects, enabling a client, or application building an HTML page for the client, to determine in advance of the request what the requirements will be.

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7.1 SINGLE FRAME IMAGE OBJECTS

7.1.1 Objects accessed

In this category are all object instances of SOP classes defined in PS 3.3 that consist of a single image frame, instances of multi-frame SOP Classes that contain only one frame, or object instances that consist of single frame accessed from instances of multi-frame SOP Classes using the "frameNumber" parameter.

7.1.2 MIME type constraints

The Server shall be able to send a response in each of the following MIME types:

- application/dicom
- image/jpeg

If the contentType parameter is not present in the request, the response shall contain an image/jpeg MIME type, if compatible with the ‘Accept’ field of the GET method.

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

Note: The choice of image/jpeg as the default for continuous tone images is a consequence of the universal support by Web Clients.

The Server should also support the following MIME types:

- image/gif
- image/png
- image/jp2

The Server may also support other MIME types.

7.2 MULTI-FRAME IMAGE OBJECTS

7.2.1 Objects included

In this category are all SOP classes defined in PS 3.3 that are multi-frame image objects.

7.2.2 MIME type constraints

The Server shall be able to send a response in the following MIME type:

- application/dicom

If the contentType parameter is not present in the request, the response shall contain a application/dicom MIME type.

The Server should also support the following MIME type:

- video/mpeg
- image/gif

The Server may also support other MIME types.

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7.3 TEXT OBJECTS

7.3.1 Objects included

In this category are all SOP classes defined in PS 3.3 that include the SR Document Content Module.

Note: This includes all SOP Classes that are SR documents, such as narrative text, structured reports, CAD, measurement reports and key object selection documents.

7.3.2 MIME type constraints

The Server shall be able to send a response in each of the following MIME types:

- application/dicom
- text/plain
- text/html

If the contentType parameter is not present in the request, or contains only MIME types that the Server does not support, the response shall contain a text/html MIME type.

It is recommended that the Server also support the following MIME types:

- text/xml
- application/pdf
- text/rtf
- a "CDA" MIME type, in conformance to HL7 CDA, e.g. application/x-hl7-cda-level-one+xml.

The Server may also support other MIME types.

7.4 OTHER OBJECTS

7.4.1 Objects included

The category shall include all objects of all SOP classes defined in PS 3.3 that are not included in the categories described in the sections above, and which are considered in PS 3.3 as classes of persistent objects.

7.4.2 MIME type constraints

The Server shall be able to send a response in the following MIME type:

- application/dicom

The Server may also support other MIME types.

If the contentType parameter is not present in the request, the response shall contain an application/dicom MIME type.

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8 Parameters

8.1 PARAMETERS AVAILABLE FOR ALL DICOM PERSISTENT OBJECTS

Parameters specified in this section are applicable to all supported DICOM SOP Classes.

Note: To identify a DICOM Object, only one UID is required, because any UID is globally unique. However, the standard requires that the UID of the higher levels in the DICOM Information Model are specified (i.e., series and study), in order to support the use of DICOM devices that support only the baseline hierarchical (rather than extended relational) Query/Retrieve model, which requires the Study Instance UID and Series Instance UID to be defined when retrieving an SOP Instance, as defined in PS 3.4.

8.1.1 Request type

Type of request performed. This parameter is REQUIRED.

The parameter name shall be “requestType”.

The value shall be "WADO".

Note: This parameter allows other types of requests to be introduced in the future, using a similar syntax.

8.1.2 Unique identifier of the study

Study Instance UID as defined in PS 3.3. This parameter is REQUIRED.

The parameter name shall be “studyUID”.

The value shall be encoded as a Unique Identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

8.1.3 Unique identifier of the series

Series Instance UID as defined in the PS 3.3. This parameter is REQUIRED.

The parameter name shall be “seriesUID”.

The value shall be encoded as a Unique Identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

8.1.4 Unique identifier of the object

SOP Instance UID as defined in the PS 3.3. This parameter is REQUIRED.

The parameter name shall be “objectUID”.

The value shall be encoded as a unique identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

8.1.5 MIME type of the response

MIME type(s) desired by the Web Client for the response from the Server, as defined in the IETF RFC2616. This parameter is OPTIONAL.

The parameter name shall be “contentType”.

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 RFC2616.

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.

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Notes: 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).

8.1.6 Charset of the response

Character set with which the returned object is to be encoded, as defined in the IETF RFC2616. This parameter is OPTIONAL.

The parameter name shall be “charset”.

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 RFC2616.

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 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)

Notes: 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.

8.1.7 Anonymize object

Removal of all patient identification information from within the DICOM object, if not already done, as defined in PS 3.15. This parameter is OPTIONAL. It shall only be present if contentType is application/dicom.

This parameter is Optional

The parameter name shall be “anonymize”.

The value shall be “yes”.

The Server may return an error if it either cannot or refuses to anonymize that object.

The Server shall return a new SOP Instance UID if the content of the object has not already been anonymized.

Notes: 1. This standard does not introduce any security-related requirements. It is likely that the information contained within DICOM objects identifies the patient. The protocol used (that is HTTP) can be replaced by HTTPs, which is its secure extension, to protect the information in transit. The underlying DICOM implementation decides whether or not to grant access to a particular DICOM object based on whatever security policy or mechanism it has in place. A server is unlikely to fulfil a request from an unknown user (e.g., accessed via the HTTP protocol) unless it is certain that the data requested has no patient identifying information within it and has been approved for public viewing.

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2. The Anonymize object enables, for example, teaching files systems or clinical trial applications to offer an access to original images stored in a PACS, without disclosing the patients identity, and requiring storage of a (de-identified) copy of the original image. Anonymization is the responsibility of the Server. In order to preserve patient confidentiality, the Server likely will refuse to deliver an anonymized SOP instance to an unknown or unauthorized person unless the Server is certain that the SOP instance holds no patient identifying information. This would include "blanking out" any annotation area(s) containing nominative information burned into the pixels or in the overlays.

8.2 PARAMETERS FOR DICOM IMAGE PERSISTENT OBJECTS

These parameters shall only be included when a request is made for a Single Frame Image Object or Multi-Frame Image Object as defined in Section 7.2.

8.2.1 ANNOTATION ON THE OBJECT

Annotation of an object retrieved and displayed as an image. This parameter is OPTIONAL. It shall not be present if contentType is application/dicom, or is a non-image MIME type (e.g., text/*). When it is not present for an image object, no annotation may be burnt in.

When used in conjunction with a presentation state object, it shall be applied after the presentation on the image. When used in conjunction with the region parameter, it shall be applied after the selection of the region.

The parameter name shall be “annotation”. Its value is a non-empty list of one or more of the following items , separated by a "," character:

- "patient", for displaying patient information on the image (e.g. patient name, birth date,…)
- "technique", for displaying technique information of the image (e.g. image number, study date, image position,…).

Note: The exact nature and presentation of the annotation is determined by the Server. The annotation is burned into the returned image pixels.

8.2.2 Number of pixel rows

The parameter name shall be “rows”.

The value shall be expressed as an integer, representing the image height to be returned. It is OPTIONAL. It shall not be present if contentType is application/dicom.

If both “rows” and “columns” are specified, then each shall be interpreted as a maximum, and a size will be chosen for the image within these constraints, maintaining the correct aspect ratio. If the number of rows is absent and the number of columns is present, the number of rows shall be chosen in order to maintain the correct aspect ratio. If both are absent, the image (or selected region) is sent in its original size (or the size of the presentation state applied on the image), resulting as one pixel of screen image for each value in the image data matrix.

The value shall be encoded as an integer string (IS), as specified in PS 3.5.

8.2.3 Number of pixel columns

The parameter name shall be “columns”.

The value shall be expressed as an integer, representing the image width to be returned. It is OPTIONAL. It shall not be present if contentType is application/dicom.

If both “rows” and “columns” are specified, then each shall be interpreted as a maximum, and a size will be chosen for the image within these constraints, maintaining the correct aspect ratio. If the number of columns is absent and the number of rows is present, the number of columns shall be chosen in order to

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maintain the correct aspect ratio. If both are absent, the image (or selected region) is sent in its original size (or the size of the presentation state applied on the image), resulting as one pixel of screen for one pixel of the image.

The value shall be encoded as an integer string (IS), as specified in PS 3.5.

8.2.4 Region of the image

This parameter allows selection of a rectangular region of an image matrix to be retrieved. The purpose of this parameter is to allow a user to view a selected area of the image matrix, for example at higher magnification.

The parameter is OPTIONAL.

The parameter name shall be “region”.

It shall not be present if contentType is application/dicom.

The value shall be expressed as a list of four positive decimal strings, separated by the ',' character, representing the region of the source image to be returned. These decimal values shall be values in a normalized coordinate system relative to the size of the original image matrix measured in rows and columns, with values ranging from 0.0 to 1.0, and representing in the following order:

- the x position of the top left hand corner of the region to be retrieved, 0.0 corresponding to the first column of the image matrix.
- the y position of the top left hand corner of the region to be retrieved, 0.0 corresponding to the top row of the image matrix.
- the x position of the bottom right hand extent of the region, 1.0 corresponding to the last column of the image matrix, 0.0 being forbidden.
- the y position of the bottom right hand extent of the region, 1.0 corresponding to the last row of the image matrix, 0.0 being forbidden.

Note: The Server may or may not support this parameter.

If this parameter is supported, an image matrix corresponding to the specified region shall be returned with size corresponding to the specified normalized coordinate values otherwise the complete image matrix shall be returned If the presentationUID parameter is present, the region shall be selected after the corresponding presentation state has been applied on the image.

8.2.5 Window center of the image

The parameter name shall be “windowCenter”.

Controls the luminosity of the image as defined in PS 3.3. This parameter is REQUIRED if "windowWidth" is present. This parameter shall not be present if there is a presentationUID parameter. It shall not be present if contentType is application/dicom.

The value shall be encoded as a decimal string (DS), as specified in PS 3.5.

8.2.6 Window width of the image

The parameter name shall be “windowWidth”.

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Controls the contrast of the image as defined in PS 3.3. It is REQUIRED if "windowCenter" is present. This parameter shall not be present if there is a presentationUID parameter. It shall not be present if contentType is application/dicom.

The value shall be encoded as a decimal string (DS), as specified in PS 3.5.

8.2.7 Frame Number

The parameter name shall be “frameNumber".

Specifies that the single frame with that number within a multi-frame image object, as defined in PS 3.3 that shall be returned. It is OPTIONAL and shall be ignored in the case of all objects other than multi-frame objects. It shall not be present if contentType is application/dicom.

The value shall be encoded as an integer string (IS), as specified in PS 3.5.

8.2.8 Image Quality

The parameter name shall be “imageQuality". It is OPTIONAL. It shall not be present if contentType is application/dicom, except if the transferSyntax parameter is present and corresponds to a lossy compression.

If the requested MIME type is for a lossy compressed image (e.g. image/jpeg), this parameter indicates the required quality of the image to be returned within the range 1 to 100, 100 being the best quality.

Note: Decompression and recompression may degrade the image quality if the original image was already irreversibly compressed. In case 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 recompressing it.

The value shall be encoded as an integer string (IS), as specified in PS 3.5.

Note: The specific interpretation of the meaning of this parameter is left to the interpretation of the implementers of the standard.

8.2.9 Unique identifier of the presentation object

The parameter name shall be “presentationUID".

SOP Instance UID of the presentation state storage object to be applied to the image. This parameter is OPTIONAL. It shall not be present if contentType is application/dicom.

The value shall be encoded as a unique identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

If this parameter is combined with region and/or annotation parameter(s), the presentation state shall be applied to the image prior to selecting a region and burning in annotations.

If the Presentation Size Mode in the presentation state is SCALE TO FIT or TRUE SIZE, then the displayed area specified in the presentation shall be scaled to fit the size specified by the rows and columns parameters if present, otherwise the displayed area selected in the presentation state will be returned without scaling.

Notes: 1. The intent of the TRUE SIZE mode in the presentation state cannot be satisfied, since the physical size of the pixels displayed by the web browser is unlikely to be known. If the Presentation Size Mode in the presentation state is MAGNIFY, then the displayed area specified in the presentation shall be magnified (scaled) as specified in the presentation state. It will then be cropped to fit the size specified by the rows and columns parameters, if present.

2. Any Displayed Area relative annotations specified in the presentation state are rendered relative to the Specified Displayed Area within the presentation state, not the size of the returned image.

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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 PS 3.14), the grayscale or color space for the image returned by the request is not defined by this standard.

8.2.10 Unique identifier of the series containing the presentation object

The parameter name shall be “presentationSeriesUID".

Series Instance UID of the series containing the presentation state storage object to be applied on the image. This parameter is REQUIRED and shall only be present if "presentationUID" is present.

The value shall be encoded as a unique identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

Note: As specified in DICOM, the Presentation State will be in the same study as the image it applies to.

8.2.11 Transfer Syntax UID

The parameter name shall be “transferSyntax".

The Transfer Syntax to be used within the DICOM image object, as specified in PS 3.6. This parameter is OPTIONAL. It shall not be present if contentType is other than application/dicom.

By default the DICOM object(s) returned shall be encoded in Explicit VR Little Endian. Neither Implicit VR, nor Big Endian shall be used. The response shall be the Transfer Syntax requested if possible. If it is not possible for the response to be sent using the requested transfer syntax then the Explicit VR Little Endian Uncompressed Transfer Syntax shall be used.

The value shall be encoded as an unique identifier (UID) string, as specified in PS 3.5, except that it shall not be padded to an even length with a NULL character.

--`,,```,,,,````-`-`,,`,,`,`,,`---

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Annex A - URL/URI Transfer Syntax (informative)

Access to the content of a data object is enabled by specifying a "link" pointing to a specific DICOM Persistent Object by means of its URL/URI and specifying its DICOM object Instance UID and the transfer syntax to be employed.

Extension to searching DICOM objects from a Server is out of the scope of the present standard. Differences between "Web Accessing" and "Searching" are mainly:

1) "Web Accessing" means retrieving an object as a "binary" answer: "I have it, I give it to you" or "I haven't". In fact, the negative answer will be a "Void" object or an error.

2) "Searching" means querying for objects has a "fuzzy answer": "I have a list of potential candidates to your question - see above the (possible void) list of their reference -".

The general syntax of the standard respects the URI recommendation IETF RFC2396. It can be expressed as:

<scheme>://<authority><path>?<query>

It is structured following BNF syntax. The first definition of this syntax is:

1) URI-reference = [absoluteURI | relativeURI] ["#" fragment]

2) absoluteURI = scheme ":" (hier_part | opaque_part)

3) relativeURI = (net_path | abs_path | rel_path) ["?" query]

4) hier_part = (net_path | abs_path) ["?" query]

The present standard aims only to define the term query, and not the other components of the URL/URI that are defining the path way from the Web Client System to the Web Enabled DICOM System, independent of the DICOM Persistent Object itself. However it is anticipated that, if present, scheme value is HTTP, in order to be compatible with web browsers.

This definition of the term query shall respect fully the BNF syntax exposed in the IETF RFC2396. Within a query component, the characters ";", "/", "?", ":", "@", "&", "=", "+", ",", and "$" are reserved. It is only a restriction of it for the unique purpose of retrieving DICOM Persistent Objects through Web Access to DICOM Persistent Objects.

Note: Management of the HTTP returns different codes (e.g. "404 Not found") as specified in IETF RFC2616.

Control names and values are escaped. Space characters are replaced by "+", and then reserved characters are escaped as described in IETF RFC2396. Non-alphanumeric characters are replaced by "%HH", a percent sign and two hexadecimal digits representing the ASCII code of the character. Line breaks are represented as "CR LF" pairs (i.e., "%0D%0A").

The control names/values are listed in the order they appear in the document. The name is separated from the value by "=" and name/value pairs are separated from each other by "&".

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Syntax of the <query> component

The BNF syntax restriction of parameters for the Web Access to DICOM Persistent Objects service is the following:

1) query = parameter ["&" parameter]

2) parameter = name "=" value

3) name = nchars

4) value = nchars

5) nchars = *nchar

6) nchar = unreserved | escaped

where unreserved and escaped are defined in IETF RFC2396.

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Annex B - Examples (Informative)

B.1 RETRIEVING A SIMPLE DICOM IMAGE IN JPEG

```
http://www.hospital-stmarco/radiology/wado.php?requestType=WADO
&studyUID=1.2.250.1.59.40211.12345678.678910
&seriesUID=1.2.250.1.59.40211.789001276.14556172.67789
&objectUID=1.2.250.1.59.40211.2678810.87991027.899772.2
```

B.2 RETRIEVING A DICOM SR IN HTML

```
http://server234/script678.asp?requestType=WADO
&studyUID=1.2.250.1.59.40211.12345678.678910
&seriesUID=1.2.250.1.59.40211.789001276.14556172.67789
&objectUID=1.2.250.1.59.40211.2678810.87991027.899772.2
&charset=UTF-8
```

B.3 RETRIEVING A REGION OF A DICOM IMAGE

Retrieving a region of a DICOM image, converted if possible in JPEG2000, with annotations burned into the image containing the patient name and technical information, and mapped into a defined image size:

```
https://aspradio/imageaccess.js?requestType=WADO
&studyUID=1.2.250.1.59.40211.12345678.678910
&seriesUID=1.2.250.1.59.40211.789001276.14556172.67789
&objectUID=1.2.250.1.59.40211.2678810.87991027.899772.2
&contentType=image%2Fjp2;level=1,image%2Fjpeg;q=0.5
&annotation=patient,technique
&columns=400
&rows=300
&region=0.3,0.4,0.5,0.5
&windowCenter=-1000
&windowWidth=2500
```

B.4 RETRIEVING AS A DICOM MIME TYPE

Retrieving a DICOM image object using the baseline 8-bit lossy JPEG transfer syntax, and de-identified:

```
http://www.medical-webservice.st/RetrieveDocument?requestType=WADO
&studyUID=1.2.250.1.59.40211.12345678.678910
&seriesUID=1.2.250.1.59.40211.789001276.14556172.67789
&objectUID=1.2.250.1.59.40211.2678810.87991027.899772.2
&contentType=application%2Fdicom
&anonymize=yes
&transferSyntax=1.2.840.10008.1.2.4.50
```


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Annex C – Applications (Informative)

There are multiple applications, in which DICOM and "web-based" environments are interacting. "Web-based" means information and communication systems that are using Internet related technologies (Web, e-mail…). The basic feature supported by this standard is a mechanism for the "Web-based" system to retrieve a DICOM persistent object from the "DICOM-based" system.

Typical applications are:

i) Referencing an image or a report from an electronic patient record (EPR)

ii) Including references to images in an e-mail

iii) Providing access by outside referring doctors to a hospital web server that contains references to reports, images and waveforms

iv) Providing access to anonymized DICOM reports, images and waveforms via a web server, for teaching purposes and for clinical trials.

To retrieve DICOM persistent objects using "WADO", the "web-based" system must "know" the UIDs (Study, Series, SOP Instance) of the objects it needs to retrieve. These may be obtained through different methods (reception of a standardized message containing a document containing the reference to the DICOM objects, query of other systems…) that are beyond the scope of this standard.

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Annex D - IANA Mapping (informative)

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

IANA	DICOM	Character Set
ISO-8859-1	ISO_IR 100	Latin alphabet #1
ISO-8859-2	ISO_IR 101	Latin alphabet #2
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 87	Japanese
ISO-2022-KR	ISO 2022 IR 149	Korean
GB18030	GB18030	Chinese
UTF-8	ISO_IR 192	Unicode

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