

Final Text - Supplement 1

Digital Imaging and Communications in Medicine (DICOM)

Part 10 : Media Storage and File Format for Media Interchange

Addenda on Directory, Media Storage Service Class and Data Dictionary

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Table of Contents

2		
4	Foreword	v
	Part 10 : Media Storage and File Format for Media Interchange	1
6		
	Foreword	2
8		
	1 Scope and Field of Application	3
10		
	2 References	5
12	2.1 Normative References	5
14		
	3 Definitions	6
	3.1 Reference Model Definitions	6
16	3.2 Service Conventions Definitions	6
	3.3 Presentation Service Definitions	6
18	3.4 DICOM Introduction and Overview Definitions	6
	3.5 DICOM Information Object Definitions	6
20	3.6 DICOM Data Structure and Encoding definitions	6
	3.7 DICOM Message Exchange definitions	7
22	3.8 DICOM Media Storage and File Format definitions	7
24		
	4 Symbols and Abbreviations	9
26		
	5 Conventions	10
28		
	6 DICOM Models for Media Storage	11
	6.1 General DICOM Communication Model	11
30	6.2 The DICOM Media Storage Model	12
	6.2.1 Physical Media Layer	13
32	6.2.2 Media Format Layer	13
	6.2.3 DICOM Data Format Layer	13
34	6.2.3.1 DICOM SOP Classes	13
	6.2.3.2 Concept of the DICOM File Format	14
36	6.2.3.3 DICOM Medical Information Directory	14
	6.2.4 DICOM Media Storage Application Profiles	14
38	6.2.5 Media Storage and the DICOM Standard Structure	15
40		
	7 DICOM File Format	16
	7.1 DICOM File Meta Information	17
42	7.2 Data Set Encapsulation	20
	7.3 Support of File Management Information	20
44		

	8 DICOM File Service	20
2	8.1 File-set	21
	8.2 File IDs	22
4	8.3 File Management Roles and Services	23
	8.4 File Content Access	24
6	8.5 Character Set	25
	8.6 Reserved DICOMDIR File ID	25
8		
	9 Conformance Requirements	26
10		
	Annex Z (Informative) - Example of DICOMDIR File Content	27
12	Z.1 Simple Directory Content Example	27
	Z.2 Example of DICOMDIR File Content with Multiple Referenced Files	30
14	Part 3 Addendum Basic Directory Information Object Definition	35
16	B.X Basic Directory Information Object Definition	36
	B.X.1 Scope of the Basic Directory Information IOD	36
18	B.X.2 Basic Directory IOD Overview	37
	B.X.2.1 Basic Directory IOD Organization	37
20	B.X.2.2 Example of a Directory	40
	B.X.2.2.1 Illustration of the Overall Directory Organization	40
22	B.X.2.2.2 Example of a DICOMDIR File Structure	42
	B.X.3 Basic Directory Information Object Definition	44
24	B.X.3.1 Module Table	44
	B.X.3.2 Modules of the Basic Directory Information Object	44
26	B.X.3.2.1 File-set Identification Module	44
	B.X.3.2.2 Directory Information Module	45
28	B.X.4 Basic Directory IOD Information Model	49
	B.X.5 Definition of Specific Directory Records	51
30	B.X.5.1 Patient Directory Record Definition	52
	B.X.5.2 Study Directory Record Definition	52
32	B.X.5.3 Series Directory Record Definition	53
	B.X.5.4 Image Directory Record Definition	53
34	B.X.5.5 Standalone Overlay Directory Record Definition	54
	B.X.5.6 Standalone Modality LUT Directory Record Definition	55
36	B.X.5.7 Standalone VOI LUT Directory Record Definition	55
	B.X.5.8 Standalone Curve Directory Record Definition	56
38	B.X.5.9 Topic Directory Record Definition	56
	B.X.5.10 Visit Directory Record Definition	57
40	B.X.5.11 Results Directory Record Definition	57
	B.X.5.12 Interpretation Directory Record Definition	58
42	B.X.5.13 Study Component Directory Record Definition	58
	B.X.5.14 Print Queue Directory Record Definition	59
44	B.X.5.15 Film Session Directory Record Definition	59
	B.X.5.16 Film Box Directory Record Definition	60

	B.X.5.17 Basic Image Box Directory Record Definition	61
2	B.X.6 Special Directory Records	61
	B.X.6.1 Private Directory Record Definition	61
4	B.X.6.2 Multi-Referenced File Directory Record Definition	61
	B.X.7 Icon Image Key Definition	62
6		
	Annex A (Informative) - Index to Attribute Tags	64
8	Part 4 Addendum Media Storage Service Class For Media Interchange	67
10	Annex X (Normative) - Media Storage Service Class	68
	X.1 Overview	68
12	X.1.1 Scope	68
	X.1.2 Service Definition	68
14	X.2 Behavior	68
	X.2.1 Behavior of an FSC	68
16	X.2.2 Behavior of an FSR	69
	X.2.3 Behavior of an FSU	69
18	X.3 Conformance	70
	X.3.1 Conformance as an FSC	70
20	X.3.2 Conformance as an FSR	71
	X.3.3 Conformance as an FSU	71
22	X.3.4 Conformance Statement Requirements	72
	X.3.5 Standard Extended, Specialized and Private Conformance	73
24	X.4 Media Storage Standard SOP Classes	73
	Part 6 Addendum Basic Directory Data Dictionary	75
26		

Foreword

2 ACR (the American College of Radiology) and NEMA (the National Electrical Manufacturers
3 Association) formed a joint committee to develop a Standard for Digital Imaging and
4 Communications in Medicine. This DICOM Standard was developed according to the NEMA
5 Procedures. The ACC (American College of Cardiology) has decided to join this standardization
6 effort with a particular interest in the definition of Digital Media Storage Standards.

8 This Standard was developed in liaison with other Standard Organizations including CEN TC251 in
9 Europe and JIRA in Japan, with review also by other organizations including IEEE, HL7 and ANSI
10 in the USA.

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

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

16 The first nine Parts of DICOM were approved in October 1993:

17	PS 3.1	—	Introduction and Overview
18	PS 3.2	—	Conformance
	PS 3.3	—	Information Object Definitions
20	PS 3.4	—	Service Class Specifications
	PS 3.5	—	Data Structures and Encoding
22	PS 3.6	—	Data Dictionary
	PS 3.7	—	Message Exchange
24	PS 3.8	—	Network Communication Support for Message Exchange
	PS 3.9	—	Point-to-Point Communication Support for Message Exchange
26	PS 3.13	—	Print Management Point-to-Point Communication Support

28 These Parts are independent but related documents. They focus on the communication of digital
29 image data across point-to-point and network interfaces. This Supplement to the DICOM Standard
30 addresses the open media interchange of medical images in files or on removable storage media. It
31 takes into account past and current related efforts:

- 32 - The ACR-NEMA Standard for Magnetic Tape (PS1) has defined a generic means to store
33 on a 9 track magnetic tape one or more Data Sets formatted per the ACR-NEMA V2.0
34 Standard;
- 35 - A Japanese effort called IS&C (Image Save and Carry) has also used an ACR-NEMA
36 V2.0 based format to store images on an 130 millimeter or 5 1/4 Inch Magneto-Optical
37 Disk with an IS&C specific media organization format;

- A European effort initiated by the University of Geneva in Switzerland has defined PAPHYRUS, an ACR-NEMA V2.0 based format to store one or more images grouped as folders in files irrespective of the physical media and its file organization format. The new PAPHYRUS V3.0 is intended to be compatible with this Supplement to the DICOM Standard.

This DICOM Supplement includes a new Part, PS 3.10 which lays a foundation for two other Parts of the DICOM Standard:

- PS 3.11 - Media Storage Application Profiles;
- PS 3.12 - Media Formats and Physical Media for Data Interchange.

As both network communication and media interchange share a number of common characteristics, significant parts of the existing Parts of DICOM are leveraged:

- PS 3.3 - Information Object Definitions;
- PS 3.4 - Service Class Specifications;
- PS 3.5 - Data Set Structures and Encoding;
- PS 3.6 - Data Dictionary.

This Supplement also includes a number of addenda to existing Parts of the DICOM Standard:

- PS 3.3 Addenda - Basic Directory Information Object Definition;
- PS 3.4 Addenda - Media Storage and Media Print Service Classes;
- PS 3.6 Addenda - Data Dictionary Extensions for Common Media storage functions.

ACC-ACR-NEMA

**Digital Imaging and Communications
in Medicine (DICOM)**

**Part 10 :
Media Storage and File Format for
Media Interchange**

Foreword

ACR (the American College of Radiology) and NEMA (the National Electrical Manufacturers Association) formed a joint committee to develop a Standard for Digital Imaging and Communications in Medicine. This DICOM Standard was developed according to the NEMA Procedures. The ACC (American College of Cardiology) has decided to join this standardization effort with a particular interest in the definition of Digital Media Storage Standards.

This Standard was developed in liaison with other Standard Organizations including CEN TC251 in Europe and JIRA in Japan, with review also by other organizations including IEEE, HL7 and ANSI in the USA.

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.

DICOM PS 3.10 is an additional part of the DICOM Standard and is added to the following existing Parts:

PS 3.1	—	Part 1 : Introduction and Overview
PS 3.2	—	Part 2 : Conformance
PS 3.3	—	Part 3 : Information Object Definitions
PS 3.4	—	Part 4 : Service Class Specifications
PS 3.5	—	Part 5 : Data Structures and Encoding
PS 3.6	—	Part 6 : Data Dictionary
PS 3.7	—	Part 7 : Message Exchange
PS 3.8	—	Part 8 : Network Communication Support for Message Exchange
PS 3.9	—	Part 9 : Point-to-Point Communication Support for Message Exchange
PS 3.13	—	Part 13 : Print Management Point-to-Point Communication Support

These Parts are independent but related documents.

PS 3. 4, PS 3.7, PS 3.8 and PS 3. 9 focus on the communication of digital image data across point-to-point and network interfaces. PS 3.10 of the DICOM Standard addresses the open media interchange of medical images in files or on removable storage media. It takes into account past and current related efforts:

- The ACR-NEMA Standard for Magnetic Tape (PS1) has defined a generic means to store on a 9 track magnetic tape one or more Data Sets formatted per the ACR-NEMA V2.0 Standard;

- 2 - A Japanese effort called IS&C (Image Save and Carry) has also used an ACR-NEMA V2.0 based format to store images on an 130 millimeter or 5 1/4 Inch Magneto-Optical Disk with an IS&C specific media organization format;
- 4 - A European effort initiated by the University of Geneva in Switzerland has defined POPYRUS, an ACR-NEMA V2.0 based format to store one or more images grouped as
6 folders in files irrespective of the physical media and its file organization format. The
8 new POPYRUS V3.0 is intended to be a specific Application Profile compatible with this Part of the DICOM Standard.

10 As both network communication and media interchange share a number of common characteristics, significant parts of DICOM are leveraged by the general framework defined by this Part. In particular, the following Parts are leveraged:

- 12 - PS 3.3 - Information Object Definitions;
- 14 - PS 3.5 - Data Set Structures and Encoding;
- 16 - PS 3.6 - Data Dictionary.

PS 3.10 lays a foundation for two other Parts of the DICOM Standard:

- 18 - PS 3.11 - Media Storage Application Profiles;
- 20 - PS 3.12 - Media Formats and Physical Media for Media Interchange.

22 These Parts may need to be expanded as the technologies related to Physical Media and the clinical needs evolve. PS 3.11 and PS 3.12 are necessary for DICOM to provide a complete solution for open Media Interchange. In particular conformance to DICOM in the area of Media interchange is defined by PS 3.2 of the DICOM Standard and is based on the Application Profiles defined by PS 3.11.

26 **1 Scope and Field of Application**

28 This Part of the DICOM Standard specifies a general model for the storage of Medical Imaging information on removable media. The purpose of this Part is to provide a framework allowing the
30 interchange of various types of medical images and related information on a broad range of physical storage media.

32 This Part specifies:

- 34 - a layered model for the storage of medical images and related information on storage media. This model introduces the concept of Media Storage Application Profiles, which specify
36 application specific subsets of the DICOM Standard to which a Media Storage implementation may claim conformance. Such a conformance applies only to the writing, reading and updating
38 of the content of storage media. Specific Application Profiles are not included in this Part but in PS 3.11 of the DICOM Standard;
- 40 - a DICOM File Format supporting the encapsulation of any Information Object Definition;
- a DICOM File Service providing independence from the underlying media format and physical

media. The policies specific to the DICOMDIR file used to store the Media Storage Directory Service/Object Pair Class are also addressed.

This Part is related to other parts of the DICOM Standard in that:

- PS 3.2, Conformance, specifies the requirements which shall be met to achieve DICOM Conformance in Media Storage;
- PS 3.3, Information Object Definitions, specifies a number of Information Object Definitions (e.g., various types of images) which may be used in conjunction with this Part;
- PS 3.4, builds upon this Part to define the Media Storage Service Class;
- PS 3.5, Data Structure and Encoding, addresses the encoding rules necessary to construct a Data Set which is encapsulated in a file as specified in this Part;
- PS 3.6, Data Dictionary, contains a registry by Tag of all Data Elements related to the Attributes of Information Objects defined in PS 3.3. This index includes the Value Representation and Value Multiplicity for each Data Element;
- PS 3.11, Media Storage Application Profiles standardizes a number of choices related to a specific clinical need (selection of a Physical Medium and Media Format as well as specific Service/Object Pair Classes). It aims at facilitating the interoperability between implementations which claim conformance to the same Application Profile. PS 3.11 is intended to be extended as the clinical needs for Media Interchange evolve;
- PS 3.12, Media Formats and Physical Media for Media Interchange, defines a number of selected Physical Medium and corresponding Media Formats. These Media Formats and Physical Medium selections are referenced by one or more of the Application Profiles of PS 3.11. PS 3.12 is intended to be extended as the technologies related to Physical Medium evolve.

PS 3.10 lays a foundation for open Media interchange by standardizing an overall architecture and addressing some of the major barriers to interoperability: the definition of a DICOM File Format, a DICOM File Service and the policies associated with a Media Storage Directory structure.

NOTE: PS 3.3 specifies a general medical imaging Basic Directory Information Object Definition and PS 3.4 specifies the corresponding Media Storage Directory SOP Class which is a member of the Media Storage Service Class.

Adherence to the provisions of DICOM PS 3.10 by implementations reading, writing or updating Storage Media represents a key foundation for open Media Interchange. However, it is only with the selection of standard Physical Media and corresponding Media Formats in PS 3.12 and the use of specific Application Profiles in PS 3.11 that effective Media Interchange interoperability is achieved. Therefore, claiming conformance to DICOM PS 3.10 only, is not a valid DICOM Conformance Statement. DICOM Media Storage Conformance shall be made in relation to a PS 3.11 Application Profile according to the framework defined by PS 3.2.

2 References

2.1 Normative References

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this Standard are encouraged to investigate the possibilities of applying the most recent editions of the standards indicated below.

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

ISO 7498-1, Information Processing Systems - Open Systems Interconnection - Basic Reference Model.

ISO/TR 8509, Information Processing Systems - Open Systems Interconnection - Service Conventions

ISO 8822, Information Processing Systems - Open Systems Interconnection - Connection-Oriented Presentation Service Definition.

ISO 8859, Information Processing - 8-bit single-byte coded graphic character sets - Part 1: Latin Alphabet No. 1

NEMA PS 3.1 - Digital Imaging and Communications in Medicine - Part 1, Introduction and Overview of Part 1 through 9.

NEMA PS 3.2 - Digital Imaging and Communications in Medicine - Part 2, Conformance.

NEMA PS 3.3 - Digital Imaging and Communications in Medicine - Part 3, Information Object Definitions

NEMA PS 3.4 - Digital Imaging and Communications in Medicine - Part 4, Service Class Specifications

NEMA PS 3.5 - Digital Imaging and Communications in Medicine - Part 5, Data Structures and Encoding

NEMA PS 3.6 - Digital Imaging and Communications in Medicine - Part 6, Data Dictionary

NEMA PS 3.7 - Digital Imaging and Communications in Medicine - Part 7, Message Exchange

NEMA PS 3.8 - Digital Imaging and Communications in Medicine - Part 8, Network Communication Support for Message Exchange

NEMA PS 3.11 - Digital Imaging and Communications in Medicine - Part 11, Media Storage Application Profiles.

NEMA PS 3.12 - Digital Imaging and Communications in Medicine - Part 12, Media Formats and Physical Media for Media Interchange.

3 Definitions

2 For the purposes of this Standard the following definitions apply.

4 **3.1 Reference Model Definitions**

This Part of the Standard is based on the concepts developed in ISO 7498-1 and makes use of the following terms defined in it:

- 6 a) Application Entity;
- 8 b) Application Process;
- c) Service or Layer Service;
- 10 d) Transfer Syntax.

3.2 Service Conventions Definitions

12 This Part of the Standard makes use of the following terms defined in ISO/TR 8509:

- a) Service Provider;
- 14 b) Service User.

3.3 Presentation Service Definitions

16 This Part of the Standard makes use of the following terms defined in ISO 8822:

- a) Abstract Syntax;
- 18 b) Abstract Syntax Name.

3.4 DICOM Introduction and Overview Definitions

20 This Part of the Standard makes use of the following terms defined in PS 3.1:

- a) Attribute.

22 **3.5 DICOM Information Object Definitions**

This Part of the Standard makes use of the following terms defined in PS 3.3:

- 24 a) Information Object Definition.

3.6 DICOM Data Structure and Encoding definitions

26 This Part of the Standard makes use of the following terms defined in PS 3.5:

- a) Data Element;
- 28 b) Data Set;
- c) Data Element Type;
- 30 d) Value;

- e) Value Multiplicity;
- f) Value Representation;

3.7 DICOM Message Exchange definitions

This Part of the Standard makes use of the following terms defined in PS 3.7:

- a) Service Object Pair (SOP) Class;
- b) Service Object Pair (SOP) Instance;
- c) Implementation Class UID.

3.8 DICOM Media Storage and File Format definitions

This Part of the Standard makes use of the following terms:

3.8.1 Application Profile

A Media Storage Application Profile defines a selection of choices at the various layers of the DICOM Media Storage Model which are applicable to a specific need or context in which the media interchange is intended to be performed.

3.8.2 DICOM File Service

The DICOM File Service specifies a minimum abstract view of files to be provided by the Media Format Layer. Constraining access to the content of files by the Application Entities through such a DICOM File Service boundary ensures Media Format and Physical Media independence.

3.8.3 DICOM File

A DICOM File is a File whose content is formatted according to the requirements of this Part of the DICOM Standard. In particular such files shall contain, the File Meta Information and a properly formatted Data Set.

3.8.4 DICOMDIR File

A unique and mandatory DICOM File within a File-set which contains the Media Storage Directory SOP Class. This File is given a single component File ID, DICOMDIR.

3.8.5 File

A File is an ordered string of zero or more bytes, where the first byte is at the beginning of the file and the last byte at the end of the File. Files are identified by a unique File ID and may be written, read and/or deleted.

3.8.6 File ID

Files are identified by a File ID which is unique within the context of the File-set they belong to. A set of ordered File ID Components (up to a maximum of eight) forms a File ID.

3.8.7 File ID Component

A string of one to eight characters of a defined character set.

3.8.8 File Meta Information

The File Meta Information includes identifying information on the encapsulated Data Set. It is a mandatory header at the beginning of every DICOM File.

3.8.9 File-set

A File-set is a collection of DICOM Files (and possibly non-DICOM Files) that share a common naming space within which File IDs are unique.

3.8.10 FSC

An Application Entity that creates the DICOMDIR File (see Section 8.6) and zero or more DICOM Files.

3.8.11 FSU

An Application Entity that accesses one or more Files in a File-set.

3.8.12 FSR

An Application Entity that accesses Files, creates additional Files or deletes existing Files in a File Set. A File-set Updater makes the appropriate alterations to the DICOMDIR file reflecting the additions or deletions.

3.8.13 DICOM File Format

The DICOM File Format provides a means to encapsulate in a File the Data Set representing a SOP Instance related to a DICOM Information Object.

3.8.14 Media Format

Data structures and associated policies which organize the bit streams defined by the Physical Media into data file structures and associated file directories.

3.8.15 Media Storage Model

The DICOM Media Storage Model pertains to the data structures used at different layers to achieve interoperability through media interchange.

3.8.16 Physical Media

Material with recording capabilities for streams of bits. Characteristics of Physical Media include form factor, mechanical characteristics, recording properties and rules for recording and organizing bit streams in accessible structures.

4 Symbols and Abbreviations

2 The following symbols and abbreviations are used in this Part of the Standard.

4	ACC	American College of Cardiology
6	ACR	American College of Radiology
8	ASCII	American Standard Code for Information Interchange
10	AE	Application Entity
12	ANSI	American National Standards Institute
14	CEN/TC/251	Comite Europeen de Normalisation - Technical Committee 251 - Medical Informatics
16	DICOM	Digital Imaging and Communications in Medicine
18	FSC	File-set Creator
20	FSR	File-set Reader
22	FSU	File-set Updater
24	HL7	Health Level 7
26	IEEE	Institute of Electrical and Electronics Engineers
28	ISO	International Standards Organization
30	ID	Identifier
32	IOD	Information Object Definition
34	JIRA	Japan Industries Association of Radiation Apparatus
36	NEMA	National Electrical Manufacturers Association
38	OSI	Open Systems Interconnection
40	SOP	Service-Object Pair

42

TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VR	Value Representation

5 Conventions

Words are capitalized in this document to help the reader understand that these words have been previously defined in Section 3 of this document and are to be interpreted with that meaning.

A Tag is represented as (gggg,eeee), where gggg equates to the Group Number and eeee equates to the Element Number within that Group. Tags are represented in hexadecimal notation as specified in PS 3.5 of the DICOM Standard..

Attributes of File Meta Information are assigned a Type which indicates if a specific Attribute is required depending on the Media Storage Operations. The following Type designations are derived from the PS 3.5 designations but take into account the Media Storage environment:

- Type 1: Such Attributes shall be present with an explicit Value in files created by File-set Creators and File-set Updaters. They shall be supported by File-set Readers and File-set Updaters;
- Type 1C: Such Attributes shall be present with an explicit Value in Files created by File-set Creators and File-set Updaters if the specified condition is met. They shall be supported by File-set Readers and File-set Updaters.
- Type 2: Such Attributes shall be present with an explicit Value or with a zero-length Value if unknown, in Files created by File-set Creators and File-set Updaters. They shall be supported by File-set Readers and File-set Updaters;
- Type 2C: Such Attributes shall be present with an explicit Value or with a zero-length if unknown, in Files created by File-set Creators and File-set Updaters if the specified condition is met. They shall be supported by File-set Readers and File-set Updaters;
- Type 3: Such Attributes may be present with an explicit Value or a zero-length Value in Files created by File-set Creators and File-set Updaters. They may be supported or ignored by File-set Readers and File-set Updaters.

6 DICOM Models for Media Storage

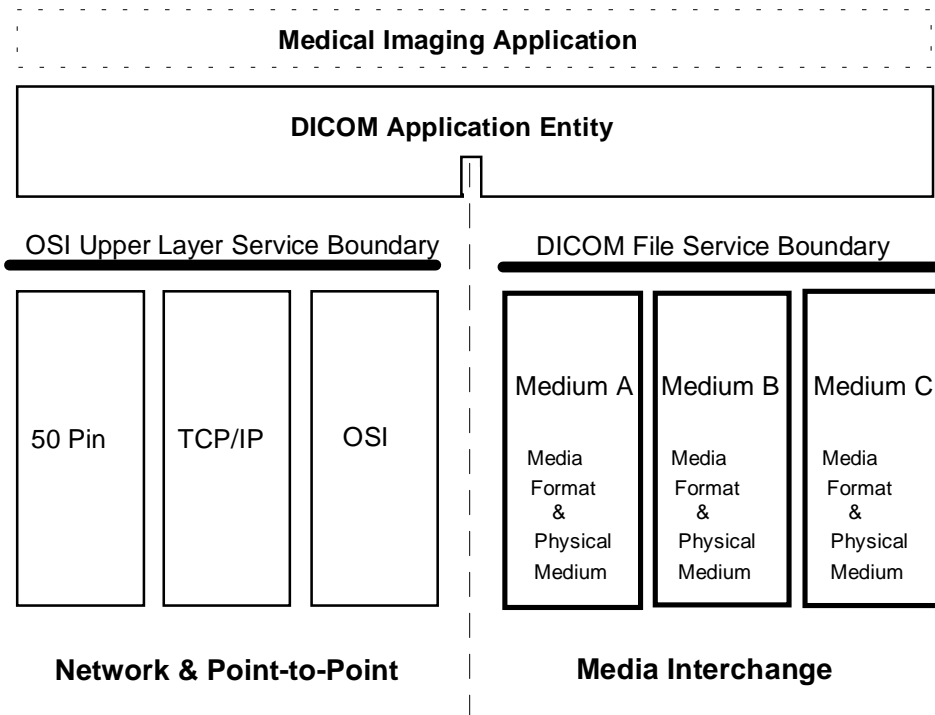
This section defines the DICOM Media Storage Model used by DICOM Application Entities for the purpose of communication through the interchange of removable storage media. Specifically, this Section provides a model to clarify a number of concepts for digital imaging and communications and introduces key terms used throughout the DICOM Standard. This model has been used to partition the DICOM Standard into separate parts related to media interchange.

6.1 General DICOM Communication Model

Figure 6.1-1 presents the general communication model of DICOM which spans network, point-to-point and media interchange communications. The DICOM Application Entities may rely on either one of the following boundaries:

- the OSI Upper Layer Service, which provides independence from specific physical networking and point-to-point communication support
- the DICOM File Service, which provides access to Storage Media independently from specific physical media storage formats and file structures.

Figure 6.1-1 General DICOM Communication Model



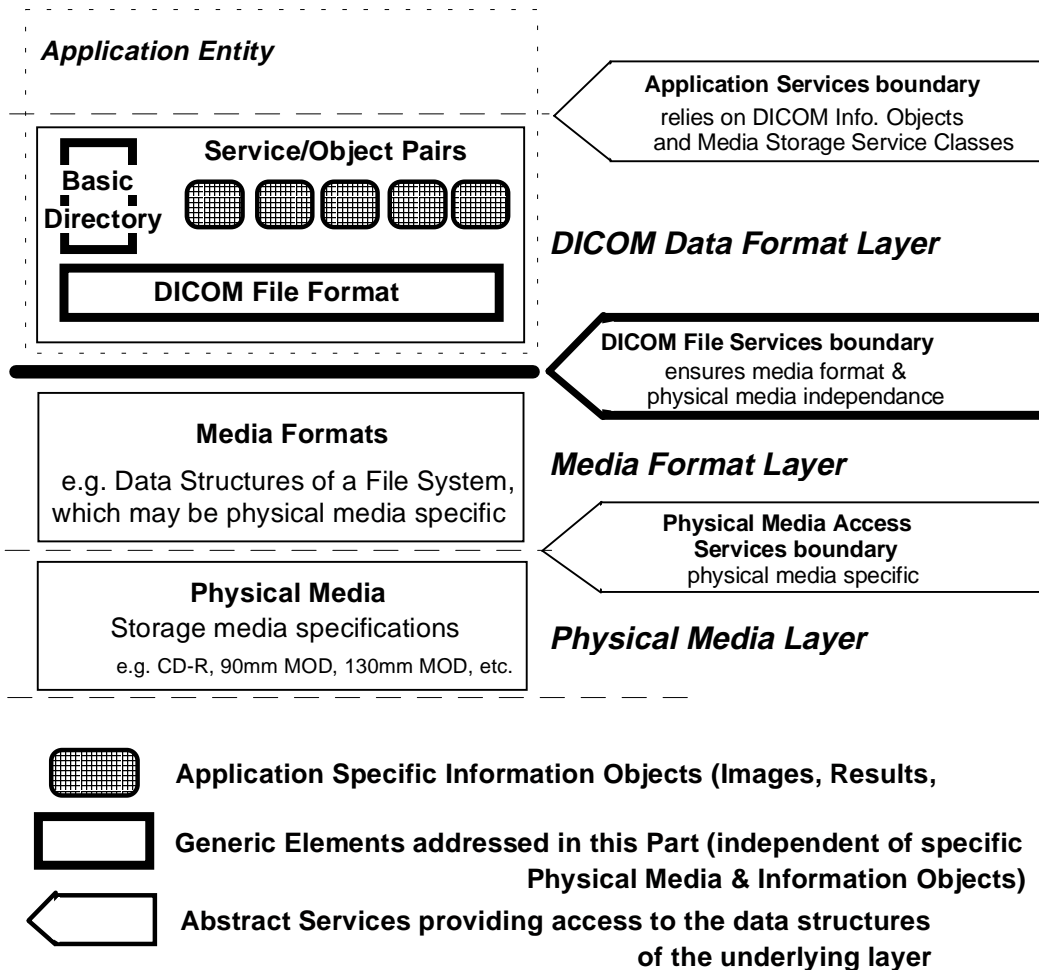
6.2 The DICOM Media Storage Model

The DICOM Media Storage Model is presented by Figure 6.2-1 and expands on the General DICOM Communication Model introduced earlier in Section 6.1.

The DICOM Media Storage Model focuses on the aspects directly related to media interchange through removable storage media. It pertains to the data structures and associated rules used at different layers to achieve interoperability through media interchange. The Services identified in this Model are simple boundaries between functional layers.

NOTE: It is not within the scope of this Standard to specify Application Programming Interfaces at these boundaries.

Figure 6.2-1 - DICOM Media Storage Model



The DICOM Media Storage Model includes three layers, which are described in the following sections.

6.2.1 Physical Media Layer

Physical media characteristics are defined at the Physical Media Layer. Such characteristics include the physical media form factor, dimension, mechanical characteristics and recording properties. This Layer also defines the organization and grouping of the recorded bits.

NOTES: 1. An example of a Physical Media Layer in the personal computer environment is the 3 1/2 inch floppy disk, double sided, high density.
2. The specification of one or more specific Physical Media for a given application is beyond the scope of this Part of the DICOM Standard. PS 3.12 of the DICOM Standard and its annexes specify several Physical Media choices. PS 3.11 defines a number of Application Profiles which select specific Physical Media depending on the requirements of specific medical imaging applications.

6.2.2 Media Format Layer

At the Media Format Layer, Physical Media bit streams are organized into specific structures. Data file structures and associated directory structures are defined to allow efficient access and management of the physical media space.

NOTE: This layer is often specific to a given operating system environment. An example of such a Media Format Layer definition associated with the 3 1/2 inch floppy disk are the data structures used by the operating systems of various personal computer file systems. PS 3.12 of the DICOM Standard and its annexes specify several Media Format choices.

Media Formats supported by the DICOM Standard are selected to support the minimum requirements specified by the DICOM File Service as specified in Section 8 of this Part. Constraining access to the File content through such a DICOM File Service ensures that the DICOM Data Format Layer is independent from Media Format and Physical Media selection.

6.2.3 DICOM Data Format Layer

The DICOM Data Format Layer includes four elements of specification:

- DICOM Media Storage SOP Classes and associated Information Object Definitions;
- The DICOM File Format;
- The DICOM Media Storage Directory SOP Class;
- DICOM Media Storage Application Profiles.

6.2.3.1 DICOM SOP Classes

DICOM SOP Classes and associated Information Object Definitions (IODs) are used to convey specific medical imaging information at the Data Format Layer. SOP Classes and IODs used for Media Storage shall follow the framework established in PS 3.3 and PS 3.4 of the DICOM Standard. Examples of such IODs are modality images, patient information, results, etc.

The use of DICOM IODs in conjunction with Media Storage Operations forms a number of Media Storage Service Object Pair Classes or SOP Classes. Media Storage Operations (e.g., read, write, delete, etc.) shall be performed through the DICOM File Service. The content of

the resulting DICOM Files shall be formatted according to the DICOM File Format as specified below.

- NOTES:
1. The concept of a SOP Class in the Media Storage context is equivalent to the concept of SOP Class introduced in PS 3.3 and PS 3.4 for network related operations (DIMSE Operations).
 2. Both Composite and Normalized IODs and SOP Classes may be used in the Media Storage context.

PS 3.4 of the DICOM Standard defines a number of SOP Classes that may be used for Media Storage. These SOP Classes are based on DICOM Standard IODs which may be found in the Annexes to DICOM PS 3.3.

The structure and encoding of a Data Set representing the data associated with a SOP Class shall follow PS 3.5 of the DICOM Standard. The specification of Transfer Syntaxes which may be used to encode such a Data Set, is also defined in PS 3.5.

6.2.3.2 Concept of the DICOM File Format

The encapsulation of a DICOM Data Set in a File shall follow the specifications of Section 7 of this Part. These encapsulation rules define a DICOM File Format able to contain in a File any DICOM Data set. Files are identified by File IDs. No semantics shall be inferred from these File IDs, nor from their structure.

- NOTE: A medical imaging application acting as a creator of a DICOM File may use semantic information to generate a File ID, but readers of DICOM files should not rely on apparent semantic content of a File ID.

Data Set encapsulation shall be based on the DICOM File Service as specified in Section 8 of this Part.

- NOTE: It is acceptable that a specific Media Format offers more file services than those specified in the DICOM File Service. Such services may be local or internal to an implementation. Their usage is beyond the scope of the DICOM Standard. However, in cases where such services are reflected in the file structures of the Media Format Layer or in the Data Set encoding of an Information Object, the extension of such services in a manner which jeopardizes interoperability should not be done (e.g., File IDs longer than those specified in the DICOM File Service).

6.2.3.3 DICOM Medical Information Directory

In addition to the DICOM Image and Image related SOP Classes (e.g., results, patients) other SOP Classes tailored for media storage may be used to provide references (or directories) based on medical information, thus facilitating access to the clinical imaging information. Such a SOP Class is the Media Storage Directory SOP Class as defined in PS 3.4 of the DICOM Standard. Instances of this SOP Class are conveyed in the File with a File ID of DICOMDIR.

6.2.4 DICOM Media Storage Application Profiles

A Media Storage Application Profile defines a selection of choices at the various layers of the DICOM Media Storage Model which are applicable to a specific need or context in which the media interchange is intended to be performed. Such choices are formally specified as a Media Storage Application Profile in order to ensure inter-operability between implementations

conforming to the same Media Storage Application Profile. It facilitates conformance statements which allow users to assess interoperability of different implementations.

Media Storage Application Profiles shall include:

- a) The description of the need addressed by the Application Profile (e.g., cardiac, echography, angiography) and its context of application;
- b) The selection, at the Data Format Layer, of a number of specific IODs and associated SOP Classes. For standard DICOM SOP Classes, this shall be done by reference to PS 3.4 of the DICOM Standard. These SOP Classes, like any other DICOM SOP Classes are assigned a unique registered UID. For each SOP Class it shall be stated if its support is required or optional within the context of the profile;
- c) The selection of a specific Media Format definition. This is done by reference to PS 3.12 of the DICOM Standard which specifies the selected Physical Medium, a specific associated Media Format and the mapping of the Media Format (or file system) services onto the DICOM File Service;
- d) The selection of appropriate Transfer Syntaxes;
- e) Other choices facilitating interoperability such as specific limits (e.g., maximum file sizes, if necessary, support of options, if any).

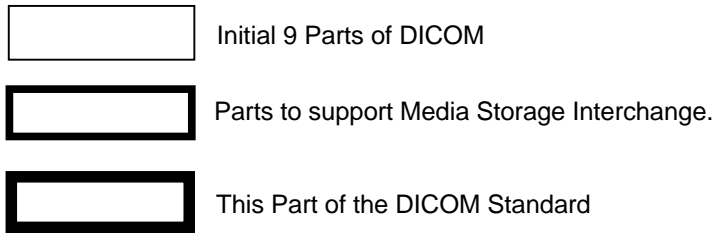
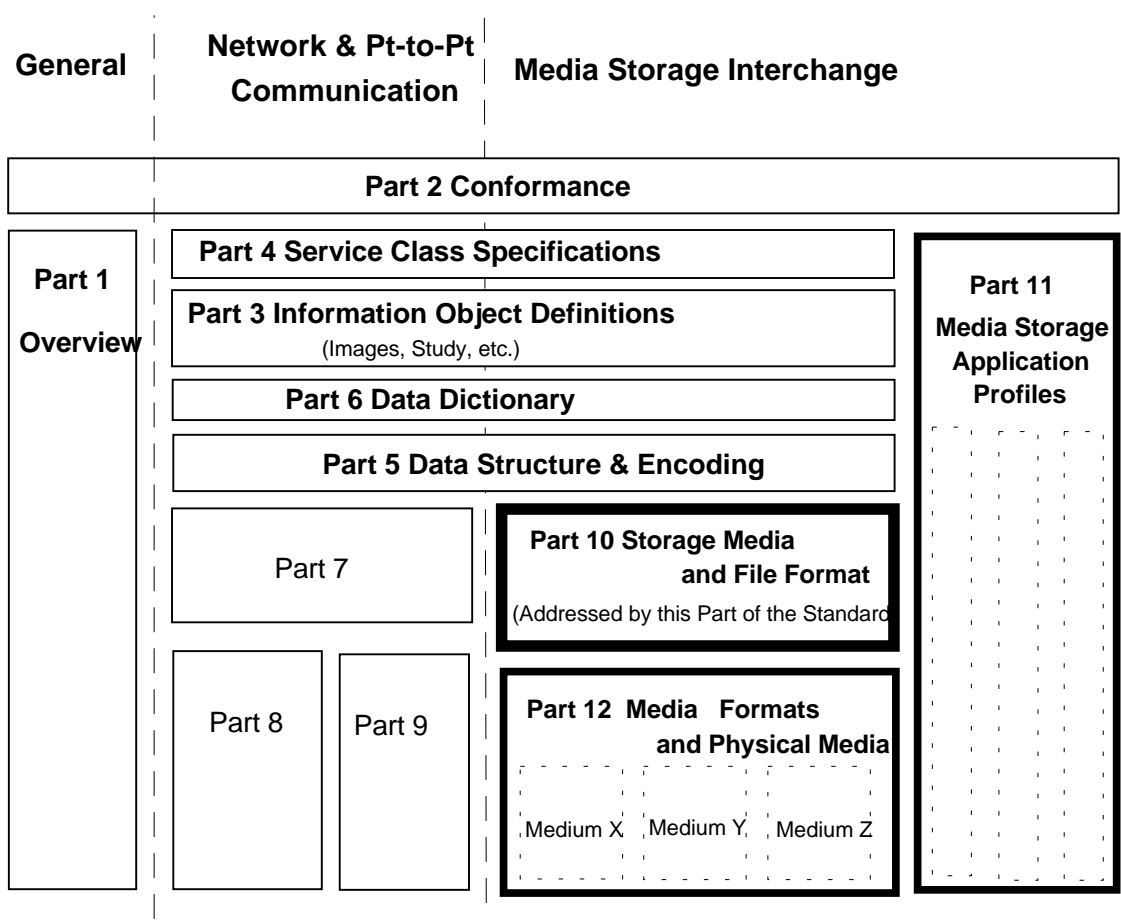
The complete definition and structure of a Media Storage Application Profiles is specified by Part 11. A number of Standard Application Profiles corresponding to different needs are included in PS 3.11.

6.2.5 Media Storage and the DICOM Standard Structure

Figure 6.2.5-1 provides an overview of the relationship between the functional areas identified by the DICOM Media Storage Model introduced in Section 6.2 and the various Parts of the DICOM Standard related to Media Storage. A number of Parts of the DICOM Standard are common between Network Communication and Media Interchange.

Figure 6.2.5-1 Media Storage and DICOM Parts

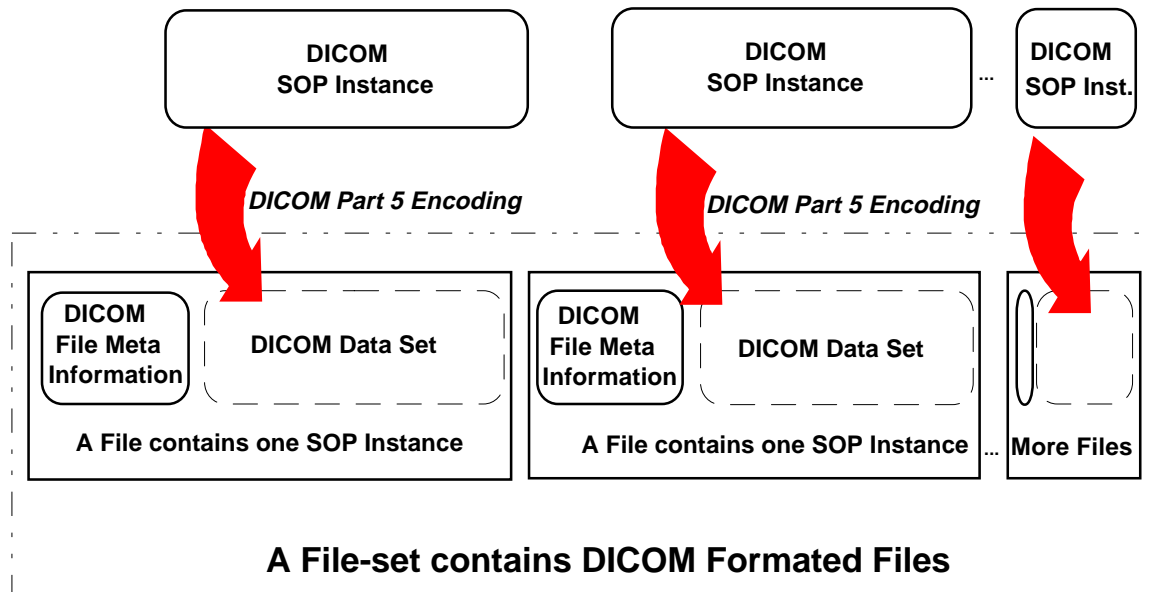
2



4

6 **7 DICOM File Format**

8 The DICOM File Format provides a means to encapsulate in a file the Data Set representing a
 10 SOP Instance related to a DICOM IOD. As shown in Figure 7-1, the byte stream of the Data Set is placed into the file after the DICOM File Meta Information. Each file contains a single SOP Instance.

Figure 7-1 File-set and File Format

7.1 DICOM File Meta Information

6 The File Meta Information includes identifying information on the encapsulated Data Set. This header consists of an 128 byte File Preamble, followed by a 4 byte DICOM prefix, followed by the File Meta Elements shown in Table 7.1-1. This header shall be present in every DICOM file.

10 The File Preamble is available for use as defined by Application Profiles or specific implementations. This Part of the DICOM Standard does not require any structure for this fixed size Preamble. It is not required to be structured as a DICOM Data Element with a Tag and a Length. It is intended to facilitate access to the images and other data in the DICOM file by providing compatibility with a number of commonly used computer image file formats. Whether or not the File Preamble contains information, the DICOM File content shall conform to the requirements of this Part and the Data Set shall conform to the SOP Class specified in the File Meta Information.

- 18 NOTES:
1. If the File Preamble is not used by an Application Profile or a specific implementation, all 128 bytes shall be set to 00H. This is intended to facilitate the recognition that the Preamble is used when all 128 bytes are not set as specified above.
 2. The File Preamble may for example contain information enabling a multi-media application to randomly access images stored in a DICOM Data Set. The same file can be accessed in two ways: by a multi-media application using the preamble and by a DICOM Application which ignores the preamble.

26 The four byte DICOM Prefix shall contain the character string "DICM" encoded as uppercase characters of the ISO 8859 G0 Character Repertoire. This four byte prefix is not structured as a DICOM Data Element with a Tag and a Length.

28

The Preamble and Prefix are followed by a set of DICOM Meta Elements with Tags and Lengths as defined in Table 7.1-1.

Table 7.1-1 DICOM File Meta Information

Attribute Name	Tag	Type	Attribute Description
File Preamble	No Tag or Length Fields	1	A fixed 128 byte field available for Application Profile or implementation specified use. If not used by an Application Profile or a specific implementation all bytes shall be set to 00H. File-set Readers or Updaters shall not rely on the content of this Preamble to determine that this File is or is not a DICOM File.
DICOM Prefix	No Tag or Length Fields	1	Four bytes containing the character string "DICM". This Prefix is intended to be used to recognize that this File is or is not a DICOM File.
Group Length	(0002,0000)	1	Number of bytes following this File Meta Element (end of the Value field) up to and including the last File Meta Element of the Group 2 File Meta Information
File Meta Information Version	(0002,0001)	1	This is a two byte field where each bit identifies a version of this File Meta Information header. In version 1 the first byte value is 00H and the second byte value is 01H. Implementations reading Files with Meta Information where this attribute has bit 0 (lsb) of the second byte set to 1 may interpret the File Meta Information as specified in this version of PS 3.10. All other bits shall not be checked. NOTE: A bit field where each bit identifies a version, allows explicit indication of the support of multiple previous versions. Future versions of the File Meta Information that can be read by version 1 readers will have bit 0 of the second byte set to 1.
Media Storage SOP Class UID	(0002,0002)	1	Uniquely identifies the SOP Class associated with the Data Set. SOP Class UIDs allowed for media storage are specified in PS 3.4 of the DICOM Standard - Media Storage Application Profiles.
Media Storage SOP Instance UID	(0002,0003)	1	Uniquely identifies the SOP Instance associated with the Data Set placed in the file and following the File Meta Information.

2	Transfer Syntax UID	(0002,0010)	1	Uniquely identifies the Transfer Syntax used to encode the following Data Set. This Transfer Syntax does not apply to the File Meta Information. NOTE: It is recommended to use one of the DICOM Transfer Syntaxes supporting explicit Value Representation encoding to facilitate interpretation of File Meta Element Values (See PS 3.5 of the DICOM Standard).
4	Implementation Class UID	(0002,0012)	1	Uniquely identifies the implementation which wrote this file and its content. It provides an unambiguous identification of the type of implementation which last wrote the file in the event of media interchange problems. It follows the same policies as defined by PS 3.7 of the DICOM Standard (association negotiation).
6	Implementation Version Name	(0002,0013)	3	Identifies a version for an Implementation Class UID (0002,0012) using up to 16 characters of the repertoire identified in Section 8.5. It follows the same policies as defined by PS 3.7 of the DICOM Standard (association negotiation).
8	Source Application Entity Title	(0002,0016)	3	The DICOM Application Entity (AE) Title of the AE which wrote this file's content (or last updated it). If used, it allows the tracing of the source of errors in the event of media interchange problems. The policies associated with AE Titles are the same as those defined in PS 3.8 of the DICOM Standard.
10	Private Information Creator UID	(0002,0100)	3	The UID of the creator of the private information (0002,0102).
12	Private Information	(0002,0102)	1C	Contains Private Information placed in the File Meta Information. The creator shall be identified in (0002,0100). Required if Private Information Creator UID (0002,0100) is present.

16
18 Except for the 128 byte preamble and the 4 byte prefix, the File Meta Information shall be
20 encoded using the Explicit VR Little Endian Transfer Syntax (UID=1.2.840.10008.1.2.1) as
22 defined in DICOM PS 3.5. Values of each File Meta Element shall be padded when
necessary to achieve an even length as specified in PS 3.5 by their corresponding Value
Representation. For compatibility with future versions of this Standard, any Tag (0002,xxxx)
not defined in Table 7.1-1 shall be ignored.

24 Values of all Tags (0000,xxxx), (0002,xxxx), (0004,xxxx) and (0006,xxxx) are reserved for
26 use by this Standard and later versions of DICOM. Elements with Tags (0001,xxxx),
(0003,xxxx), (0005,xxxx) and (0007,xxxx) shall not be used for Media Interchange.

7.2 Data Set Encapsulation

Each File shall contain a single Data Set representing a single SOP Instance related to a single SOP Class (and corresponding IOD).

NOTE: A file may contain more than a single 2D image frame as specific IODs may be defined to include multiple frames.

The Transfer Syntax used to encode the Data Set shall be the one identified by the Transfer Syntax UID of the DICOM File Meta Information.

NOTE: A DICOM Data Set does not include its total length. The end of the file indication provided by the DICOM File Service (see Section 8.4) is the only indication of the end of the Data Set.

The last Data Element of a Data Set may be Data Element (FFFC,FFFC) if padding of a Data Set is desired when a file is written. The Value of this Data Set Trailing Padding Data Element (FFFC,FFFC) has no significance and shall be ignored by all DICOM implementations reading this Data Set. File-set Readers or Updaters shall be able to process this Data Set Trailing Padding (FFFC,FFFC) either in the Data Set following the Meta Information or in Data Sets nested in a Sequence (See PS 3.5 of the DICOM Standard).

7.3 Support of File Management Information

The DICOM File Format does not include file management information in order to avoid duplication with functions related to the Media Format Layer. If necessary for a given DICOM Application Profile, the following information should be offered by the Media Format Layer:

- File content owner identification;
- File access statistics (e.g. date and time of creation);
- Application file access control;
- Physical media access control (e.g., write protect).

NOTE: This version of DICOM PS 3.10 does not address media interchange security beyond the Media and File access control services that a selected Medium Format may support. The requirements for security management, beyond the efficient capabilities provided by the Physical Media Layer and/or the Media Format Layer may be considered in future versions of DICOM Media Storage Standards.

8 DICOM File Service

The DICOM File Service specifies an abstract view of files from the point of view of a service user in the Data Format Layer. Constraining access to the content of files by Application Entities through such a DICOM File Service ensures independence of the Data Format Layer functions from specific Media Format and Physical Media selections.

NOTE: This DICOM File Service definition is abstract in the sense that it is only the specification of a boundary. Its focus is limited to the aspects directly related to accessing the data structures of the Media Format Layer (not the specifications of the data structures themselves). Even though the DICOM File Service may be described by means of a number of abstract primitives such as read, write, delete, etc., it is not intended to be the definition of an Application Programming Interface (API).

The DICOM File Service specified for Media Storage offers a basic service, simple enough to be supported by a wide range of commonly available Media Formats (or file systems), but rich enough to provide the key functions to effectively manage files and access their content. The following sections specify the minimum mandatory requirements that shall be met by any physical media and associated media format to comply with the DICOM Media Storage model.

NOTE: It is acceptable that a specific Media Format offers more file services than those specified in the DICOM File Service. Such services may be internal to an implementation (i.e. not visible through the data structures on the Storage Media). Their usage is beyond the scope of the DICOM Standard. However, in cases where such services are reflected in the file structures of the Media format Layer or in the Data Set encoding an Information Object, the extension of such services in a manner which jeopardizes interoperability should not be done (e.g., File IDs longer than specified in the DICOM File Service).

8.1 File-set

The DICOM File Service offers the ability to create and access one or more files in a File-set. A File-set is a collection of files that share a common naming space within which File IDs (see Section 8.2) are unique. No semantics is attached to the order of Files within a File-set.

NOTES:

1. The DICOM File Service does not require that Files within a File-set be simultaneously accessible (e.g., sequentially accessed media such as tapes are supported).
2. The DICOM File Service does not explicitly include the notion of distributing a File-set or a File across multiple "volumes/physical medium". However the transparent support by the Media Format Layer of such a feature is not precluded.

A File ID naming space (corresponding to a File-set) shall be associated with an appropriate feature of a Media Format defined structure. This mapping shall be specified in PS 3.12 for each Media Format specification (this is integral to the specification of the relationship between any specific Media Format services and the DICOM File Services defined in this PS 3.10).

NOTE: An example of such a relationship is to map the File ID naming space to a volume in a personal computer Media Format or a partition in a workstation File System on a removable medium. Another example is to map the File ID naming space to a directory and its tree of subdirectories. In this case it could offer the possibility to support multiple File-sets (one per directory) on the same physical medium. Each File-set would have its own DICOMDIR File. To ensure interoperability, PS 3.12 shall specify the mapping rules between the directories and the File ID naming space of a File-set (including the rules to unambiguously locate the DICOMDIR File).

A single File with the File ID DICOMDIR shall be included in each File-set.

Each File-set shall be uniquely identified by a File-set UID which shall be registered according to the UID registration rules specified in PS 3.5 of the DICOM Standard. When Files are added

or removed from a File-set, the File-set UID shall not change.

A File-set may also be identified by a File-set ID, which provides a simple (but possibly not globally unique) human readable reference. A File-set ID is string of zero (0) to sixteen (16) characters from the subset of the G0 repertoire of ISO 8859 (see Section 8.5). A File-set ID may be associated or mapped to an appropriate identifier at the Media Format Layer.

- NOTES:
1. Continuing with the personal computer Media Format example used first in the previous note, a File-set ID may be defined to be identical to a volume label.
 2. Non-DICOM Files (Files with a content not formatted according to the requirements of this Part of the DICOM Standard) may be present in a File-set. Such files should not contain the DICOM File Meta Information specified in Table 7.1-1 and may not be referenced as a dicom formatted file by the DICOM Media Storage Directory (See Section 8.6).

A File-set Descriptor File (a "readme" file) may also be attached to a File-set. See PS 3.3 for a detailed specification of the Basic Directory IOD..

8.2 File IDs

Files are identified by a File ID which is unique within the context of a File-set. A File ID is an ordered sequence of File ID Components. A File ID may contain one to eight components. Each Component is a string of one to eight characters from a subset of the G0 repertoire of ISO 8859 (see Section 8.5)

Such a structure for File IDs (a sequence of components) allows the DICOM File Service to organize file selection in a hierarchical mode. No conventions are defined by the DICOM Standard for the use of the structure of File IDs components and their content (except for the reserved File ID DICOMDIR, see Section 8.6). Furthermore, no semantics shall be conveyed by the structure and content of such File IDs. This implies that when a File ID is assigned to any File in a File-set, the creating DICOM Application Entity may choose to structure the File ID as it wishes. Any other AE reading existing files or creating new files shall not be required to know any semantics the original creator may have associated with such a structure.

- NOTES:
1. A DICOM File ID is equivalent to the commonly used concept of "path name" concatenated with a "file name". An example of a valid DICOM File ID with four components shown separated by backslashes is: SUBDIR1\SUBDIR2\SUBDIR3\ABCDEFGH
 2. As specified in the DICOM Storage Media Model, no semantics is attached to File ID content and structure as it relates to the DICOM Information Objects stored in these files. If used, the hierarchical structure simply provides a means to organize the Files of a File-set and facilitate their selection.
 3. The DICOM File Service does not specify any "separator" between the Components of the File ID. This is a Value Representation issue which may be addressed in a specific manner by each Media Format Layer. In DICOM IODs, File ID Components are generally handled as multiple Values and separated by "backslashes". There is no requirement that Media Format Layers use this separator.

8.3 File Management Roles and Services

When DICOM Application Entities participate in the exchange of information by the interchange of Storage Media, they perform through the DICOM File Service a number of Media Storage Operations:

- M-WRITE, to create new files in a File-set and assign them a File ID;
- M-READ to read existing files based on their File ID;
- M-DELETE to delete existing files based on their File ID;
- M-INQUIRE FILE-SET to inquire free space available for creating new files within the File-set;
- M-INQUIRE FILE to inquire date and time of file creation (or last update if applicable) for any file within the File-set.

A DICOM Application Entity may take one or more of the following three roles:

1. File-set Creator (FSC). Such an Application Entity exercises this role by means of M-WRITE Operations to create the DICOMDIR File (see Section 8.6) and zero or more DICOM Files;
2. File-set Reader (FSR). Such an Application Entity exercises this role by means of M-READ Operations to access one or more Files in a File-set. A File-set Reader shall not modify any of the files of the File-set (including the DICOMDIR File);
3. File-set Updater (FSU). Such an Application Entity exercises this role by means of M-READ, M-WRITE, and M-DELETE Operations. It reads, but shall not modify, the content of any of the DICOM files in a File-set except for the DICOMDIR File. An FSU may read or modify the contents of DICOMDIR. It may create additional Files by means of an M-WRITE or delete existing Files in a File-set by means of an M-DELETE.

NOTE: Although a File-set Updater (FSU) may include the functions corresponding to a File-set Creator (FSC) and a File-set Reader (FSR), it is not required that implementations supporting an FSU role also support an FSC or an FSR role.

The use of the concept of roles in DICOM Conformance Statements will result in a more precise expression of the capabilities of implementations supporting DICOM Media Storage. Conforming implementations shall support one of the following choices:

- a) Be a File-set Creator
- b) Be a File-set Reader
- c) Be a File-set Creator and a File-set Reader
- d) Be a File-set Updater
- e) Be a File-set Updater and a File-set Creator
- f) Be a File-set Updater and a File-set Reader
- g) Be a File-set Updater, a File-set Creator and a File-set Reader

Based on the roles supported by a DICOM Application Entity, the DICOM File Service shall support the Media Operations defined in Table 8.3-1.

Table 8.3-1 Media Operations and roles

Media Operations Roles	M-WRITE	M-READ	M-DELETE	M-INQUIRE FILE-SET	M-INQUIRE FILE
FSC	Mandatory	<i>Not required</i>	<i>Not required</i>	Mandatory	<i>Not required</i>
FSR	<i>Not required</i>	Mandatory	<i>Not required</i>	<i>Not required</i>	Mandatory
FSC+FSR	Mandatory	Mandatory	<i>Not required</i>	Mandatory	Mandatory
FSU	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
FSU+FSC	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
FSU+FSR	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory
FSU+FSC+FSR	Mandatory	Mandatory	Mandatory	Mandatory	Mandatory

- NOTES:
1. Media Preparation is outside the scope of this Part of the DICOM Standard. However it is assumed to be performed by the FS Creator.
 2. The DICOM File Service does not require that file update capabilities (e.g., append) be supported by every Media Format Definition selected. The non-support of such file update capabilities to the DICOMDIR File may simply result in having to delete and create a new file in order to keep the directory information consistent.
 3. If the content of a file needs to be updated or changed by an FSU, it is considered by this Part of the DICOM Standard as an M-DELETE Operation followed by an M-WRITE Operation. The FSU is responsible to ensure the internal consistency of the File and its conformance to PS 3.10 and to the specific SOP Class stored, exactly as if the FSU was creating a new File. In particular, if an FSU implementation needs to update the file content but is not able to recognize and fully process the content of the File Preamble (See Section 7.1), it may consider setting the 128 bytes of the Preamble to 00H. This would avoid introducing inconsistencies between the content of the File Preamble and the remainder of the file content. An example of this situation may occur when a TIFF IFD 0 Offset in the File Preamble points at a further TIFF IFDs embedded in the DICOM Data Set and the update operation changes the location of this embedded TIFF IFD.

8.4 File Content Access

The DICOM File Service offers the ability to access the content of any File in a File-set. The File content is an ordered string of zero or more bytes, where the first byte is at the beginning of the file and the last byte at the end of the File.

NOTE: This File content definition as an ordered string of bytes is related to the view provided at the DICOM File Service level. It may not correspond to the physical ordering of bytes of data on a specific medium.

The DICOM File Service shall manage the delimitation of the end of the File by ensuring the user of the File Service that read access beyond the last byte will be detected and reported to the DICOM File Service user. This delimitation function is performed by the Media Format Layer.

The DICOM File Service shall offer the ability:

- for an FSR or FSU to perform an M-READ to read zero or more bytes of the content of a File;
- for an FSC or FSU to perform an M-WRITE to write one or more bytes making the content of a File.

NOTE: The DICOM File Service does not require any specific capability for the selective read access or write access of the content of a file (e.g., seek or append). However it does not restrict specific Media Format definitions to support such features.

8.5 Character Set

File IDs and File-set IDs shall be character strings made of characters from a subset of the GO repertoire of ISO 8859. The following characters form this subset:

A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z (uppercase)
1, 2, 3, 4, 5, 6, 7, 8, 9, 0 and _ (underscore)

NOTES: 1. This is the character set defined for Control Strings (Value Representation CS - see PS 3.5 of the DICOM Standard) except that SPACE is not included.
2. This character set is selected to limit characters in File IDs and File-set IDs to those that do not conflict with reserved characters and delimiters in the file systems defined in PS 3.12. Component delimiters or other required demarcations defined in PS 3.12 are not part of File IDs or File-set IDs.

8.6 Reserved DICOMDIR File ID

A single File with a File ID, DICOMDIR, shall exist as a member of every File-set. This File ID is made of a single Component (see Section 8.2 for the File ID structure). It contains the DICOM Media Storage Directory (see PS 3.3 for detailed specification of the Basic Directory IOD) which includes general information about the whole File-set. This general information is always present, but optionally the directory content may be left empty in environments where it would not be needed. If the DICOMDIR File does not exist in a File-set, the File-set does not conform to PS 3.10 of the DICOM Standard. The DICOMDIR shall not reference Files outside of the File-set to which it belongs.

NOTES: 1. Two examples of content of the DICOMDIR File may be found in Annexes of PS 3.4
2. If one chooses to map the origin of a File-set to a specific directory node in a specific Media Format, the File IDs, including the DICOMDIR File IDs, would be relative to this directory node path name.

The DICOMDIR File shall use the Explicit VR Little Endian Transfer Syntax (UID=1.2.840.10008.1.2.1) to encode the Media Storage Directory SOP Class. The DICOMDIR File shall comply with the DICOM File Format specified in Section 7 of this Standard. In particular:

- a) the SOP Class UID in the File Meta Information (header of the DICOMDIR File) shall have the Value specified in PS 3.4 of this Standard for the Media Storage Directory SOP Class;

2 b) the SOP Instance UID in the File Meta Information (header of the DICOMDIR File)
shall contain the File-set UID Value. The File-set UID is assigned by the Application
4 Entity which created the File-set (FSC role, see Section 8.3) with zero or more DICOM
Files. This File-set UID Value shall not be changed by any other Application Entities
reading or updating the content of the File-set;

6 NOTES: 1. This policy reflects that a File-set is an abstraction of a "container" within which Files may be
created or read. The File-set UID is related to the "container" not its content. A File-set in the
8 DICOM File Service is intended to be mapped to a supporting feature of a selected Media Format
(e.g., volume or partition).

10 2. The Standard does not prevent the making of duplicate copies of a File-set (i.e., a File-set with the
12 same File-set UID). However, within a managed domain of File-sets, a domain specific policy may
be used to prevent the creation of such duplicate File-sets.

14 9 Conformance Requirements

An implementation of PS 3.10 of the DICOM Standard:

- 16 a) shall have a Conformance Statement based on a PS 3.11 Application Profile in
accordance with the framework defined in PS 3.2;
- 18 b) shall meet the requirements of the DICOM File Format as specified in Section 7 of this
Part;
- 20 c) shall support the DICOM File Service as specified in Section 8 of this Part, in one or
more of the roles identified in Section 8.3;
- 22 d) shall perform the Media Operations defined in Table 8.3-1 according to the role
supported;
- 24 e) shall support the DICOMDIR File with a content as specified in the Media Storage
Directory SOP Class in PS 3.4 of this Standard;

Add to PS 3.10 the following Annex Z:

Annex Z (Informative) - Example of DICOMDIR File Content

This Annex provides an example of a File content which is based on selected aspects of the example introduced in PS 3.3 for the Basic Directory Information Object. This is not a normative Annex. It is only an illustration, which is simply intended to help the reader better understand the organization of a DICOM Directory stored in a DICOMDIR File.

Z.1 Simple Directory Content Example

Table Z.1-1 shows in a simplified manner, the content of a simple (i.e. without Multiple Referenced Files) DICOMDIR File. Values of elements are noted between square brackets (e.g. [1.840.10008.34.7.6]). Byte Offsets are shown by symbolic Values noted between curly brackets (e.g. {1493}).

Table Z.1-1 Directory Content Example

Meta-Info	128 bytes 4 bytes 0002,0000 0002,0001 0002,0002 0002,0003 0002,0010 0002,0012 ...	File Preamble [all bytes set to 00H] DICOM Prefix [DICM] Group Length File Meta-Information Version [0001] SOP Class UID [1.2.840.10008.1.3.10] SOP Instance UID [1.840.23856.36.45.3] Transfer Syntax UID [1.840.10008.1.1] Implementation Class UID [1.840.23856.34.90.3] ...
File-set Identification	0004,1130 ...	File-set ID [EXAMPLE] ...
General Directory Information	0004,1200 0004,1202 0004,1212 ... 0004,1220	Offset of First Record of Root Directory Entity {1236} Offset of Last Record of Root Directory Entity {6F18} File-set Consistency Flag [0000H] ... Directory Record Sequence. This Data Element Value includes the following Sequence of Items.

{1236}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Patient B Directory Record	0004,1400	Offset of the next Directory Record in Dir. Entity {1493}
		0004,1410	Record In-Use Flag [FFFFH]
		0004,1420	Offset of Referenced Lower Level Dir. Entity (not shown in example)
		...	
		0004,1430	Directory Record Type [PATIENT]
Selection Keys		0004,1500	Referenced File ID [DIR\THRE\KC48]
		0004,1510	Referenced SOP Class UID in File [1.840.10008.3.1.2.1.1]
		0004,1511	Referenced SOP Instance UID in File [1.840.23856.3.9879]
		0004,1512	Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
		0010,0010	Patient Name [Patient B]
		0010,0020	Patient ID [550-31-8623]
	
Item Del. Tag		FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined Length

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{1493}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Patient A Directory Record	0004,1400 0004,1410 0004,1420 ... 0004,1430	Offset of the next Dir. Record in Dir. Entity {6F18} Record In-use Flag [FFFFH] Offset of Referenced Lower Level Directory Entity {1829} ... Directory Record Type [PATIENT]
	<i>Selection Keys</i>	0004,1500 0004,1510 0004,1511 0004,1512 0010,0010 0010,0020	Referenced File ID [DIR\TDRE\GC48] Referenced SOP Class UID in File [1.840.10008.3.1.2.1.1] Referenced SOP Instance UID in File [1.840.23856.3.9789] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2] Patient Name [Patient A] Patient ID [535-71-7321]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{1829}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Study 1 Directory Record	0004,1400 0004,1410 0004,1420 ... 0004,1430	Offset of the next Dir. Record in Dir. Entity (not shown in example) Record In-use Flag [FFFFH] Offset of Referenced Lower Level Directory Entity {2299} ... Directory Record Type [STUDY]
	<i>Selection Keys</i>	0020,000D 0020,0010	Study Instance UID [1.840.4656.23.4568745] Study ID [srt78UJ]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{2299}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Series 1 Directory Record	0004,1400 0004,1410 0004,1420 ... 0004,1430	Offset of the next Dir. Record in Dir. Entity (not shown in example) Record In-use Flag [0FFFFH] Offset of Referenced Lower Level Directory Entity {2681} ... Directory Record Type [SERIES]
	<i>Selection Keys</i>	0008,0060 0020,0011	Modality [NM] Series Number [2]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{2681}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Image 1 Directory Record	0004,1400 0004,1410 0004,1420 ... 0004,1430	Offset of the next Dir. Record in Dir. Entity {3419} Record In-use Flag [FFFFH] Offset of Referenced Lower Level Directory Entity [00000000H] ... Directory Record Type [IMAGE]
	<i>Selection Keys</i>	0004,1500 0004,1510 0004,1511 0004,1512 0008,0018 0020,0013	Referenced File ID [DIR\TDRI\3856G3] Referenced SOP Class UID in File [1.840.10008.5.1.4.1.1.5] Referenced SOP Instance UID in File [1.840.34.56.78999654.234] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.1] Image SOP Instance UID [1.840.34.56.78999654.234] Image Number [1]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{3419}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)

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Image 2 Directory Record	0004,1400	Offset of the next Dir. Record in Dir. Entity (not shown in example)
	0004,1410	Record In-use Flag [FFFFH]
	0004,1420	Offset of Referenced Lower Level Directory Entity [00000000H]

	0004,1430	Directory Record Type [IMAGE]
<i>Selection Keys</i>	0004,1500	Referenced File ID [DIR\TDRI\3856G7]
	0004,1510	Referenced SOP Class UID in File [1.840.10008.5.1.4.1.1.5]
	0004,1511	Referenced SOP Instance UID in File[1.840.34.56.78999654.235]
	0004,1512	Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	0008,0018	Image SOP Instance UID [1.840.34.56.78999654.235]
	0020,0013	Image Number [2]

Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length

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{6F18}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Patient C	0004,1400	Offset of the next Dir. Record in Dir. Entity {00000000H}
	Directory	0004,1410	Record In-use Flag [FFFFH]
	Record	0004,1420	Directory Record Type [PATIENT]

<i>Selection Keys</i>	0010,0010	Patient Name [Patient C]	
	0010,0020	Patient ID [523-61-8765]	
	
Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length	

Sequence Delimitation Tag	FFFE,E0DD	Used only if the Directory Record Sequence (0004,1220) is of undefined length to delimit the end of the Value of the Directory Record Sequence Data Element.
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Z.2 Example of DICOMDIR File Content with Multiple Referenced Files

This Section provides an example of a File content which depicts the use of multiple referenced files. It is only an illustration, which is simply intended to help the reader better understand the organization of such a DICOM Directory stored in a DICOMDIR File.

Figure Z.2-1 shows schematically the content of a DICOMDIR file created by an FSC in the case of off-line printing of two sheets of film. Three cases of reference by Directory Record to Files are included:

- direct reference by a single Directory Record (without an MRDR Directory Record)
- indirect reference by two Directory Records through an MRDR Directory Record
- indirect reference by a single Directory Record but with an MRDR Directory Record

Figure Z.2-1 Example of Directory Content

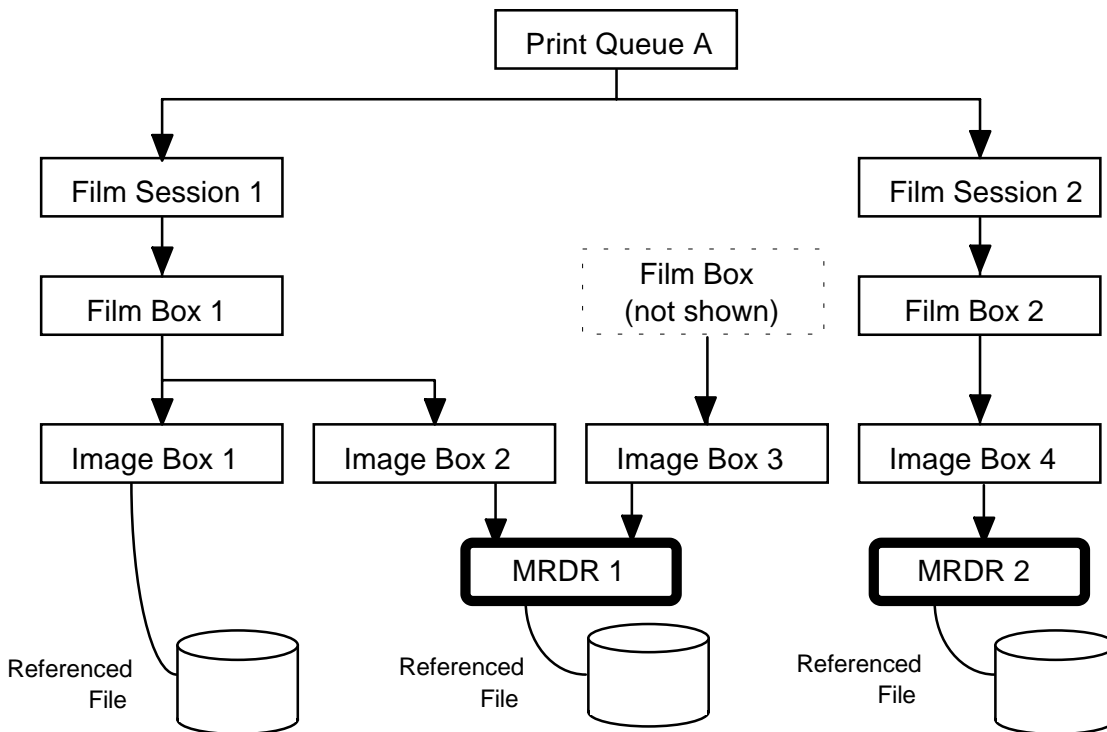


Table Z.2-1 shows in a simplified manner, the content of such a DICOMDIR File. Values of Meta and Directory Elements are noted between square brackets (e.g. [1.840.10008.34.7.6]). Byte Offsets are shown by symbolic Values noted between curly brackets (e.g. {1493}).

Table Z.2-1 Multi-Referenced Directory Content Example

2	Meta-Info	128 bytes 4 bytes 0002,0000 0002,0001 0002,0002 0002,0003 0002,0010 0002,0012 ...	File Preamble [contains 128 bytes set to 00H] DICOM Prefix [DICM] Group Length File Meta-Information Version [0001] SOP Class UID [1.2.840.10008.1.3.10] SOP Instance UID [1.840.23856.96.4465.3008] Transfer Syntax UID [1.840.10008.1.1] Implementation Class UID [1.840.23856.34.90.3] ...
4	File-set Identification	0004,1130 ...	File-set ID [MULT-REF EXAMPLE] ...
6	General Directory Information	0004,1200 0004,1202 0004,1212 ... 0004,1220	Offset of First Record of Root Directory Entity {1236} Offset of Last Record of Root Directory Entity {MRDR-2} File-set Consistency Flag [0000H] ... Directory Record Sequence. This Data Element Value includes the following Sequence of Items.

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12	{1236}	<table border="1"> <tr> <td>Item Tag</td> <td>FFFE,E000</td> <td>Item Data Element (includes the following Data Elements)</td> </tr> <tr> <td>Print Queue A</td> <td>0004,1400</td> <td>Offset of the next Directory Record in Dir. Entity {0000}</td> </tr> <tr> <td>Directory Record</td> <td>0004,1410</td> <td>Record In-Use Flag [FFFFH]</td> </tr> <tr> <td></td> <td>0004,1420</td> <td>Offset of Referenced Lower Level Dir. Entity {FS-1}</td> </tr> <tr> <td></td> <td>...</td> <td></td> </tr> <tr> <td></td> <td>0004,1430</td> <td>Directory Record Type [PRINT QUEUE]</td> </tr> <tr> <td></td> <td>0004,1500</td> <td>Referenced File ID [DIR\THRE\KC48]</td> </tr> <tr> <td></td> <td>0004,1510</td> <td>Referenced SOP Class UID in File [1.840.10008.34.7.6]</td> </tr> <tr> <td></td> <td>0004,1511</td> <td>Referenced SOP Instance UID in File [1.840.23856.3.9879]</td> </tr> <tr> <td></td> <td>0004,1512</td> <td>Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]</td> </tr> <tr> <td><i>Selection Keys</i></td> <td>2110,0030</td> <td>Printer Name [BW PRINTER]</td> </tr> <tr> <td></td> <td>2110,0099</td> <td>Print Queue ID [URGENT]</td> </tr> <tr> <td></td> <td>....</td> <td>....</td> </tr> <tr> <td>Item Del. Tag</td> <td>FFFE,E00D</td> <td>Item Delimitation Tag is present only if Item is of undefined Length</td> </tr> </table>	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)	Print Queue A	0004,1400	Offset of the next Directory Record in Dir. Entity {0000}	Directory Record	0004,1410	Record In-Use Flag [FFFFH]		0004,1420	Offset of Referenced Lower Level Dir. Entity {FS-1}		...			0004,1430	Directory Record Type [PRINT QUEUE]		0004,1500	Referenced File ID [DIR\THRE\KC48]		0004,1510	Referenced SOP Class UID in File [1.840.10008.34.7.6]		0004,1511	Referenced SOP Instance UID in File [1.840.23856.3.9879]		0004,1512	Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]	<i>Selection Keys</i>	2110,0030	Printer Name [BW PRINTER]		2110,0099	Print Queue ID [URGENT]		Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined Length	
Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)																																											
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	0004,1430	Directory Record Type [PRINT QUEUE]																																											
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	0004,1510	Referenced SOP Class UID in File [1.840.10008.34.7.6]																																											
	0004,1511	Referenced SOP Instance UID in File [1.840.23856.3.9879]																																											
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Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined Length																																											
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18	{FS-1}	<table border="1"> <tr> <td>Item Tag</td> <td>FFFE,E000</td> <td>Item Data Element (includes the following Data Elements)</td> </tr> <tr> <td>Film Session 1</td> <td>0004,1400</td> <td>Offset of the next Dir. Record in Dir. Entity {FS-2}</td> </tr> <tr> <td>Directory Record</td> <td>0004,1410</td> <td>Record In-use Flag [FFFFH]</td> </tr> <tr> <td></td> <td>0004,1420</td> <td>Offset of Referenced Lower Level Directory Entity {FB-1}</td> </tr> <tr> <td></td> <td>...</td> <td>...</td> </tr> <tr> <td></td> <td>0004,1430</td> <td>Directory Record Type [FILM SESSION]</td> </tr> <tr> <td></td> <td>0004,1500</td> <td>Referenced File ID [FLM\TDRE\LC48]</td> </tr> <tr> <td></td> <td>0004,1510</td> <td>Referenced SOP Class UID in File [1.840.10008.5.1.1.1]</td> </tr> <tr> <td></td> <td>0004,1511</td> <td>Referenced SOP Instance UID in File [1.840.23856.3.1189]</td> </tr> <tr> <td></td> <td>0004,1512</td> <td>Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]</td> </tr> <tr> <td><i>Selection Keys</i></td> <td>2000,0050</td> <td>Film_Session_Label [Hospital de Buc]</td> </tr> <tr> <td></td> <td>2100,0020</td> <td>Execution Status [PENDING]</td> </tr> <tr> <td></td> <td>....</td> <td>....</td> </tr> <tr> <td>Item Del. Tag</td> <td>FFFE,E00D</td> <td>Item Delimitation Tag is present only if Item is of undefined length</td> </tr> </table>	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)	Film Session 1	0004,1400	Offset of the next Dir. Record in Dir. Entity {FS-2}	Directory Record	0004,1410	Record In-use Flag [FFFFH]		0004,1420	Offset of Referenced Lower Level Directory Entity {FB-1}			0004,1430	Directory Record Type [FILM SESSION]		0004,1500	Referenced File ID [FLM\TDRE\LC48]		0004,1510	Referenced SOP Class UID in File [1.840.10008.5.1.1.1]		0004,1511	Referenced SOP Instance UID in File [1.840.23856.3.1189]		0004,1512	Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]	<i>Selection Keys</i>	2000,0050	Film_Session_Label [Hospital de Buc]		2100,0020	Execution Status [PENDING]		Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length	
Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)																																											
Film Session 1	0004,1400	Offset of the next Dir. Record in Dir. Entity {FS-2}																																											
Directory Record	0004,1410	Record In-use Flag [FFFFH]																																											
	0004,1420	Offset of Referenced Lower Level Directory Entity {FB-1}																																											
																																											
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	0004,1500	Referenced File ID [FLM\TDRE\LC48]																																											
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	0004,1511	Referenced SOP Instance UID in File [1.840.23856.3.1189]																																											
	0004,1512	Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]																																											
<i>Selection Keys</i>	2000,0050	Film_Session_Label [Hospital de Buc]																																											
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26	{FS-2}	<table border="1"> <tr> <td>Item Tag</td> <td>FFFE,E000</td> <td>Item Data Element (includes the following Data Elements)</td> </tr> <tr> <td>Film Session 2</td> <td>0004,1400</td> <td>Offset of the next Dir. Record in Dir. Entity {0000}</td> </tr> <tr> <td>Directory Record</td> <td>0004,1410</td> <td>Record In-use Flag [FFFFH]</td> </tr> <tr> <td></td> <td>0004,1420</td> <td>Offset of Referenced Lower Level Directory Entity {FB-2}</td> </tr> <tr> <td></td> <td>...</td> <td>...</td> </tr> <tr> <td></td> <td>0004,1430</td> <td>Directory Record Type [FILM SESSION]</td> </tr> </table>	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)	Film Session 2	0004,1400	Offset of the next Dir. Record in Dir. Entity {0000}	Directory Record	0004,1410	Record In-use Flag [FFFFH]		0004,1420	Offset of Referenced Lower Level Directory Entity {FB-2}			0004,1430	Directory Record Type [FILM SESSION]																									
Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)																																											
Film Session 2	0004,1400	Offset of the next Dir. Record in Dir. Entity {0000}																																											
Directory Record	0004,1410	Record In-use Flag [FFFFH]																																											
	0004,1420	Offset of Referenced Lower Level Directory Entity {FB-2}																																											
																																											
	0004,1430	Directory Record Type [FILM SESSION]																																											

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<i>Selection Keys</i>	0004,1500 0004,1510 0004,1511 0004,1512	Referenced File ID [FLM\TE\LC5867] Referenced SOP Class UID in File [1.840.10008.5.1.1.1] Referenced SOP Instance UID in File [1.840.23856.3.7889] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.1]
	2100,0020 2000,0050	Film_Session_Label [Geneva Hospital] Execution Status [PENDING]
Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length

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{FB-1}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Film Box 1 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity {0000} Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity {IB-1} ...
		0004,1430	Directory Record Type [FILM BOX]
		0004,1500 0004,1510 0004,1511 0004,1512	Referenced File ID [F56\TE\L86TY7] Referenced SOP Class UID in File [1.840.10008.5.1.1.2] Referenced SOP Instance UID in File [1.840.23856.3.740899] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	<i>Selection Keys</i>	2100,0020 ...	Execution Status [PENDING]

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	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{FB-2}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Film Box 2 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity {0000} Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity {IB-4} ...
		0004,1430	Directory Record Type [FILM BOX]
		0004,1500 0004,1510 0004,1511 0004,1512	Referenced File ID [F56\TE\L8HKY7] Referenced SOP Class UID in File [1.840.10008.5.1.1.2] Referenced SOP Instance UID in File [1.840.23856.3.740900] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.1]
	<i>Selection Keys</i>	2100,0020 ...	Execution Status [PENDING]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length

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{IB-1}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Image Box 1 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity {IB-2} Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity {00000000H} ...
		0004,1430	Directory Record Type [IMAGE BOX]
		0004,1500 0004,1510 0004,1511 0004,1512	Referenced File ID [F56\TE\L8FCCCX] Referenced SOP Class UID in File [1.840.10008.5.1.1.4] Referenced SOP Instance UID in File [1.840.23856.3.740981] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	<i>Selection Keys</i>	2020,0010 ...	Image Position [1]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length

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{IB-2}	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Image Box 2 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity {00000000H} Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity {00000000H} ...
		0004,1430	Directory Record Type [IMAGE BOX]

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		0004,1500 0004,1504 0004,1510 0004,1511 0004,1512	Referenced File ID [<i>null</i>] MRDR Directory Record Offset { MRDR-1 } Referenced SOP Class UID in File [1.840.10008.5.1.1.4] Referenced SOP Instance UID in File [1.840.23856.3.740982] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	<i>Selection Keys</i>	2020,0010 ...	Image Position [2] ...
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{ IB-3 }	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Image Box 3 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity (not shown on this example) Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity { 00000000H } ...
		0004,1430	Directory Record Type [IMAGE BOX]
		0004,1500 0004,1504 0004,1510 0004,1511 0004,1512	Referenced File ID [<i>null</i>] MRDR Directory Record Offset { MRDR-1 } Referenced SOP Class UID in File [1.840.10008.5.1.1.4] Referenced SOP Instance UID in File [1.840.23856.3.740982] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	<i>Selection Keys</i>	2020,0010 ...	Image Position [8] ...
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{ MRDR-1 }	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	MRDR 1 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity { 00000000H } Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity { 00000000H } ...
		0004,1430	Directory Record Type [MRDR]
		0004,1500 0004,1600	Referenced File ID [F56\TE\L8FCCCY] Number of References [2]
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{ IB-4 }	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	Image Box 4 Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity { 00000000H } Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity { 00000000H } ...
		0004,1430	Directory Record Type [IMAGE BOX]
		0004,1500 0004,1504 0004,1510 0004,1511 0004,1512	Referenced File ID [<i>null</i>] MRDR Directory Record Offset { MRDR-2 } Referenced SOP Class UID in File [1.840.10008.5.1.1.4] Referenced SOP Instance UID in File [1.840.23856.3.740996] Referenced Transfer Syntax UID in File [1.2.840.10008.1.2.2]
	<i>Selection Keys</i>	2020,0010 ...	Image Position [3] ...
	Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length
{ MRDR-2 }	Item Tag	FFFE,E000	Item Data Element (includes the following Data Elements)
	MRDR Directory Record	0004,1400 0004,1410 0004,1420 ...	Offset of the next Dir. Record in Dir. Entity { 00000000H } Record In-use Flag [FFFFFH] Offset of Referenced Lower Level Directory Entity { 00000000H } ...
		0004,1430	Directory Record Type [MRDR]
		0004,1500 0004,1600	Referenced File ID [F56\TE\L8FCCCZ] Number of References [1]

2		Item Del. Tag	FFFE,E00D	Item Delimitation Tag is present only if Item is of undefined length				
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8		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 25%; text-align: center;">Sequence Delimitation Tag FFFE,E0DD</td> <td colspan="3">Used only if the Directory Record Sequence (0004,1220) is of undefined length to delimit the end of the Value of the Directory Record Sequence Data Element.</td> </tr> </table>			Sequence Delimitation Tag FFFE,E0DD	Used only if the Directory Record Sequence (0004,1220) is of undefined length to delimit the end of the Value of the Directory Record Sequence Data Element.		
Sequence Delimitation Tag FFFE,E0DD	Used only if the Directory Record Sequence (0004,1220) is of undefined length to delimit the end of the Value of the Directory Record Sequence Data Element.							
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ACC-ACR-NEMA

**Digital Imaging and Communications
in Medicine (DICOM)**

**Part 3 Addendum
Basic Directory
Information Object Definition**

Add the following Section B.x to Annex B of PS 3.3

B.X Basic Directory Information Object Definition

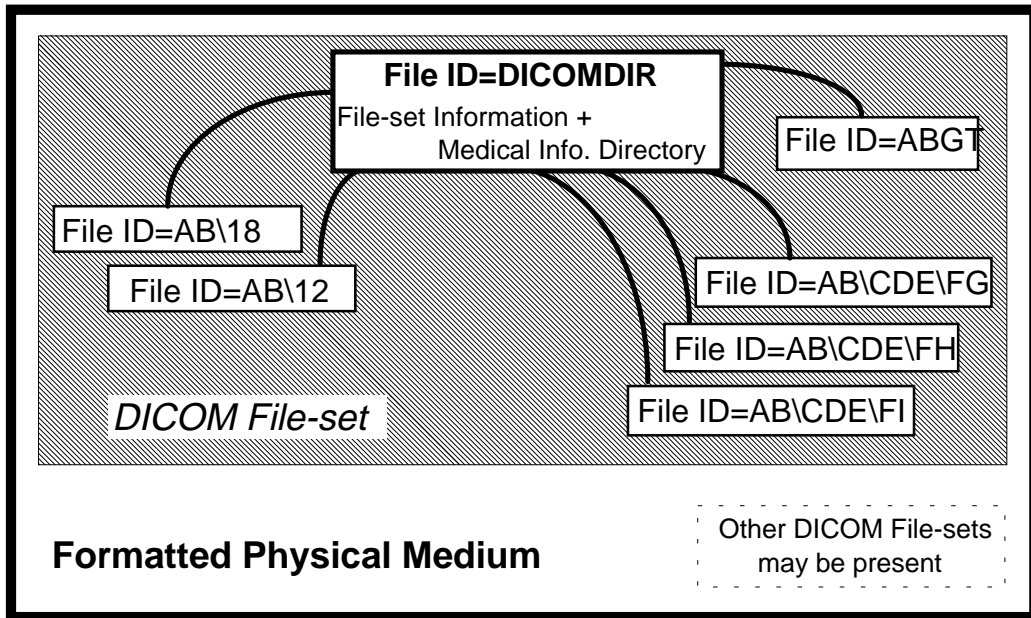
B.X.1 Scope of the Basic Directory Information IOD

The Basic Directory Information Object Definition may be used for DICOM Media Storage (See PS 3.10) and the Media Storage Service Class (See PS 3.4). It is an abstraction of the information:

1. to identify a File-set, and
2. provide a directory which facilitates access to the information stored in the files of a File-set based on key medical information. Such a directory facility relies on a hierarchical information model of medical summary information referencing the content of the Files stored in a File-set on a storage medium. Standardizing such a directory function is a key element to facilitate the interchange of medical imaging data and is intended to support the complete range of modality imaging information.

NOTE: The directory information has been defined so that a future version of this Part may be extended to support the distribution of the directory information among a logical tree of several files (with the DICOMDIR file at its root). However in this version of this Part, the entire directory information is specified to be stored in a single File with a DICOMDIR File ID.

Figure B.1-1 The DICOMDIR File. A central role in a DICOM File-set



- 2 NOTES: 1. Whether a single File-set or multiple File-sets are allowed on a formatted Physical Media is defined by the Media Format specification (used for each specific Physical Media) in PS 3.12.
- 4 2. The DICOMDIR File is identified by a single component File ID, DICOMDIR. Other files in the File-set may have File IDs made of a single component (e.g. "ABGT" in the figure above) or multiple components (e.g. AB\12 or AB\CDE\FI) not to exceed 8 components (See PS 3.10).
- 6

8 This Basic Directory Information Object:

- 10 - is based on a structure of basic medical information. It is not a file system directory such as the one which may be used by the Media Format Layer;
- 12 - is simple enough to meet the requirements of elementary Media Interchange applications;
- 14 - is efficient in supporting update to the directory on rewritable media without a complete rewrite of the entire DICOMDIR File;
- 16 - is extendible for specific applications with specialized selection keys in addition to the standard keys;
- 18 - does not mandate any relationship between the hierarchy of the medical information in the DICOM Directory and the hierarchy of the File ID Components;

20 NOTE: Such an independence between the structure of the file identifiers, from which no semantical information shall be inferred, and the DICOM Directory which conveys medical imaging information, ensures that the broadest inter-operability is possible between conforming DICOM media storage implementations.

22

24 **B.X.2 Basic Directory IOD Overview**

26 The general organization of the Basic Directory IOD is introduced in this Section. A simple example is also provided to illustrate the application of this organization.

28 **B.X.2.1 Basic Directory IOD Organization**

30 The Basic Directory IOD organization is based on a hierarchy of Directory Entities. At the origin of this inverted tree is a root Directory Entity. Each Directory Entity includes one or more Directory Records which in turn, may each reference a lower level Directory Entity.

32 Directory Records serve to reference objects stored in the Files of the File-set. The organization of the Directory is depicted by the Basic Directory IOD entity/relationship model presented in Figure B.X.2.1-1.

34

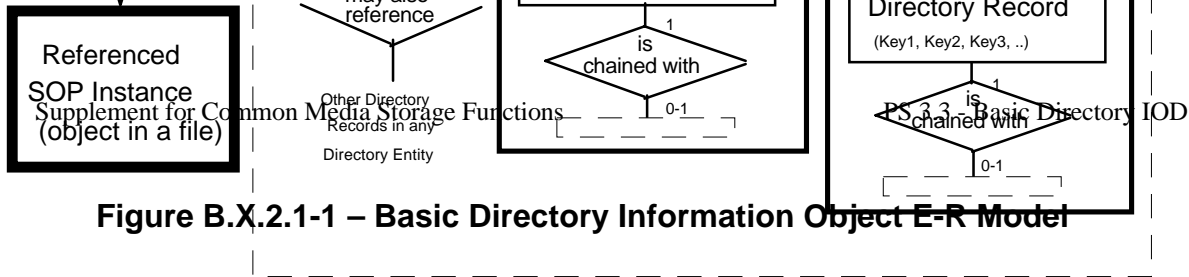


Figure B.X.2.1-1 – Basic Directory Information Object E-R Model

2

4 Each Directory Record, irrespective of the Directory Entity it is included in, contains four types of information:

- 6 1. A reference to a lower level Directory Entity or Referenced Directory Entity. This reference may be absent if such a lower level Directory Entity does not exist for an instance of a
- 8 directory record;
- 10 2. A reference to a File of the File-set in which is stored a "Referenced Object" (formally called in DICOM a Referenced SOP Instance). This reference may be absent if no File is referenced. Files may be referenced either directly by their File ID or indirectly through a
- 12 Multi-Referenced File Directory Record. The latter case allows the same File to be referenced by several Directory Records;
- 14 3. A set of "selection keys", specific to a Referenced Object, which will allow its selection among all the records included in a given Directory Entity;

2 4. A mechanism to chain the various Directory Records which belong to the same Directory Entity.

4 This generic content of a Directory Record is further specialized based on its specific type in the context the Basic Directory IOD Information Model specified in Section B.X.4 (e.g., a Study Record, a Series Record, etc.). A Directory Entity may include Directory Records of different
6 Types. By standardizing a number of specific Directory Records (see Section B.X.5) in the context of the Basic Directory IOD Information Model, one allows the definition of a variety of
8 directory contents while maintaining a framework for interoperability.

10 To facilitate the management and update of the Directory Information a number of rules are defined:
12

- 14 1) Any Lower-Level Directory Entity shall be referenced by at most one higher-level Directory Record. Not allowing multiple higher-level Directory Records to
16 reference the same Lower-Level Directory Entity simplifies the management of the deletion (or inactivation) of Directory Records and Lower-Level Directory Entities and associated Directory Records;
- 18 2) Any Directory Record (except for MRDR) shall belong to a single Directory Entity. This rule and the above rule, makes the Basic Directory IOD itself strictly
20 hierarchical;
- 22 3) All files referenced by a Directory shall be present in the same File-Set to which the directory belongs;
- 24 4) Non-DICOM files which are not referenced by the Directory may be included in the File-set space. The means of access to such Files and the semantics associated with
26 their absence from the Directory is beyond the scope of the DICOM Standard;
- 28 5) If a DICOMDIR contains a Directory Information Module, all DICOM Files of the File-set shall be referenced by a Directory Record;
- 30 6) Any File of the File-set shall be directly referenced by at most one Directory Record of the Directory. Not allowing multiple Directory Records to directly reference the
32 same File simplifies the management of the deletion of Directory Records and associated Files;
- 34 7) A single File may be referenced indirectly by several Directory Records (which may or may not belong to the same Directory Entity) through a special Directory Record
36 (called a Multi-Referenced File Directory Record). Such a Directory Record facilitates the management of Directory Record deletion (or inactivation) by keeping an explicit count of the multiple references to a single File.

38 NOTES: 1. Despite the fact that rules 1 and 2 make the DICOM Directory strictly hierarchical, rules 6 and
40 7 makes the referencing of Files fully relational. This relational flexibility allows the sharing of the content of referenced Files by different Directory Records (e.g. an image belonging to a study as well as a related film session). However, the full use of this flexibility may require the "cloning"

2 of Directory Records due to the strict hierarchy of the Directory. An example of the use of a Multi-
3 Referenced File Directory Record is shown in Annex E.

4 2. Referenced Files may contain SOP Instances of SOP Classes which provide the means to
5 reference by UIDs, other SOP Instances which may not be stored in files of the same File-set (e.g.
6 an image referencing a study component).

7 **B.X.2.2 Example of a Directory**

8 The example provided in this Section is only one simple example of a possible directory content
9 and organization. This Section is not normative in nature. Therefore, this example is not meant
10 to specify a conformant directory nor to restrict the range of possible directory organizations
11 supported by this Part of the DICOM Standard.

12 The overall organization is illustrated at a logical level in Section B.X.2.2.1. The actual structure
13 of the content is discussed in Section B.X.2.2.2. Two Annexes of PS 3.4 provide example
14 where further details of the encoding of the file content is depicted.

15 **B.X.2.2.1 Illustration of the Overall Directory Organization (informative)**

16 A simple directory content is used as an example of Directory organization. It is depicted by
17 Figure B.X.2.2.1-1. The left hand side part of Figure B.X.2.2-1 depicts the various Objects
18 stored in Files of the File-set. The right hand side presents an example of organization of the
19 directory which facilitates access to the Files of the File-set.

20 This example shows how stored Files are referenced by Directory Records which are grouped
21 into Directory Entities. The two Study Directory Records (Study 1 and Study 2) are part of the
22 Directory Entity relative to the Patient A.

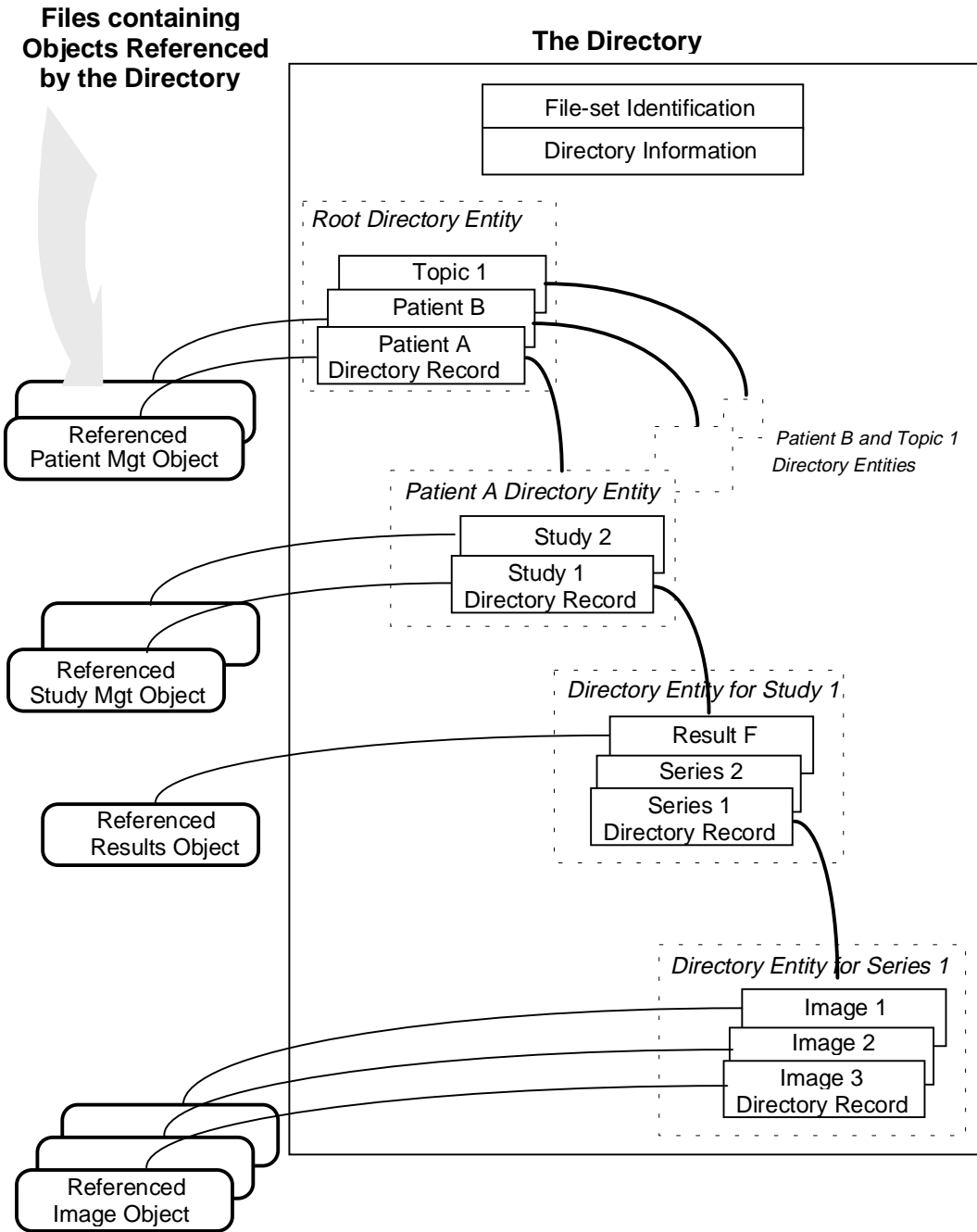
23 Thin curved lines depict the referencing mechanism based on File IDs which allow reference to
24 Files containing stored objects. Thick curved lines depict the internal referencing mechanisms
25 which support the reference to a lower-level Directory Entity by a Directory Record,.

26 Keys which are used to select a specific Directory Record from among the Directory Records
27 of a Directory Entity are not shown on Figure B.X.2.2-1.

28 One may note in this example that certain Directory Records such as the Series Directory
29 Records do not reference Files containing stored objects. Other Directory Records such as the
30 Image Directory Records do not reference lower level Directory Entities. However, a number
31 of Directory Records reference both one lower level Directory Entity and one File containing
32 a stored object. This flexibility allows the definition of a variety of directories.

Figure B.X.2.2.1-1– Example of a Directory Organization and Content

2



B.X.2.2.2 Example of a DICOMDIR File Structure

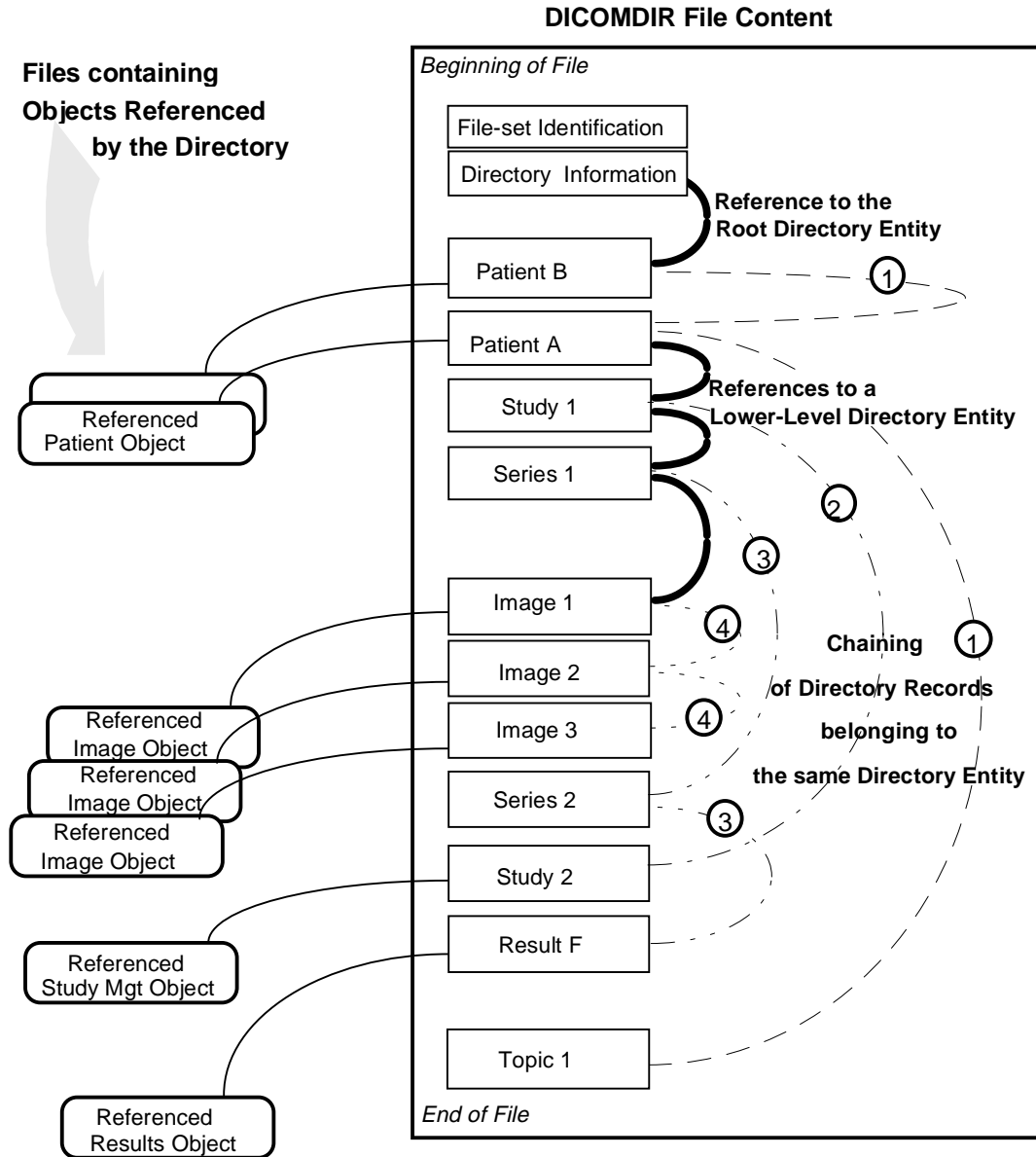
2 Based on the example discussed in Section B.X.2.2.1, the internal data structure used by the
Basic Directory IOD is depicted in Figure B.X.2.2.2-1. It shows a set of Directory Records
4 where each Directory Record is linked by three different types of "referencing" mechanisms:

- 6 1) The chaining of Directory Records to form a Directory Entity. In particular, this
facilitates the addition of new Directory Records at the level of any Directory Entity
by placing them at the end of the DICOMDIR File. On Figure B.X.2.2.2-1, these
8 chainings are shown by dotted lines:
 - 10 - #1 shows the chaining of the Directory Records forming the root Directory Entity;
 - 12 - #2 shows the chaining of the Directory Records for the Directory Entity related to
Patient A;
 - 14 - #3 shows the chaining of the Directory Records for the Directory Entity related to
Study 1;
 - 16 - #4 shows the chaining of the Directory Records for the Directory Entity related to
Series 1.
- 18 2) Thick curved lines depict the reference by a Directory Record to a lower level
Directory Entity;
- 20 3) Thin curved lines depict the reference by a Directory Record to a stored file
containing a SOP Class;

22 This example of a DICOMDIR File structure shows one example of a specific order of the
Directory Records. Other orderings of Directory Records could result in a functionally
equivalent directory.
24
26

Figure B.X.2.2-1– Example of Data Structure for the DICOM Directory Information

2
4



B.X.3 Basic Directory Information Object Definition

This IOD is based on the Directory Information organization introduced in Section B.X.2. The model for this Basic Directory IOD is described Section B.X.2.1 by the Entity/Relationship model in Figure B.X.2.1-1. The rules specified in Section B.X.2.1 apply to this Information Object Definition.

B.X.3.1 Module Table

The Basic Directory IOD includes the Modules specified by Table B.X.3.1-1.

Table B.X.3.1-1 Basic Directory IOD Modules

Module	Reference	Usage	Module Description
File-set Identification	B.X.3.2.1	M	File-set identification information
Directory Information	B.X.3.2.2	U	Directory Information followed by a Sequence of Directory Records. NOTE: The Directory Information Module is optional. This Directory Information Module should be present in all but primitive environments where a directory is not needed. In this case, only the File-set Identification Information is present.

B.X.3.2 Modules of the Basic Directory Information Object

Attributes of the Basic Directory IOD are defined with a Type designation which indicates if a specific Attribute is required for all Media Storage Operations (See Section 5, Conventions).

B.X.3.2.1 File-set Identification Module

Table B.X.3.2.1-1 File-set Identification Module

Attribute Name	Tag	Type	Attribute Description
File-set ID	(0004,1130)	2	User or implementation specific Identifier (up to 16 characters). For definition, see PS 3.10. The File-set ID is intended to be a short human readable label to easily (but not necessarily uniquely) identify a specific File-set to facilitate operator manipulation of the physical media on which the File-set is stored. Assignment of Value and semantics are environment specific.

2	File-set Descriptor File ID	(0004,1141)	3	ID of a File (in the same File-set) used for user comments related to the File-set (e.g. a readme file). The Specific Character set used may be specified in the Specific Character Set of the File-set Descriptor File (0004,1142). NOTE: This File is not DICOM formatted (no Preamble, nor DICM Prefix and Meta Information).
4	Specific Character Set of File-set Descriptor File	(0004,1142)	1C	Character set used in the File-set Descriptor File with a File ID as specified in File-set Descriptor File ID (0004,1141). Required to specify the expanded or replacement character set. If absent, only the Basic Graphic set is used. See C.12.1.1.2 for Defined Terms.

8 NOTE: Every File-set is assigned a File-set UID when created. The File-set UID need not be duplicated as a
 10 Type 1 Attribute of the File-set Identification Module. It is conveyed as the SOP Instance UID of the
 Basic Directory IOD. It is included in the DICOMDIR File Meta Information (See PS 3.10)

B.X.3.2.2 Directory Information Module

12 This Module contains a sequence of Directory Records forming one or more Directory Entities.
 14 This Module defines at least one Directory Entity, the Root Directory Entity (which may be
 empty). Each Directory Record is composed of Directory Elements (marked by a ">"). They
 include:

- 16 1. an offset pointer another Directory Record of the Same Directory Entity
- 17 2. an offset pointer to a lower level Directory Entity
- 18 3. a Referenced File pointed to by the Directory Record
- 19 4. a set of keys representative of the information contained in the Referenced File

20 **Table B.X.3.2.2-1 Directory Information Module**

22	Attribute Name	Tag	Type	Attribute Description
24	Offset of the First Directory Record of the Root Directory Entity	(0004,1200)	1	Offset of the first byte (of the Item Data Element) of the first Directory Record of the Root Directory Entity. This Offset is a number of bytes starting with the first byte of the File Meta Information. When the Root Directory Entity contains no Directory Record, this offset shall be set to 00000000H. NOTE: This offset includes the File Preamble and the DICM Prefix.
28	Offset of the Last Directory Record of the Root Directory Entity	(0004,1202)	1	Offset of the first byte (of the Item Data Element) of the last Directory Record of the Root Directory Entity. This Offset is a number of bytes starting with the first byte of the File Meta Information. When the Root Directory Entity contains no Directory Record, this offset shall be set to 00000000H. NOTE: This offset includes the File Preamble and the DICM Prefix.

2	File-set Consistency Flag	(0004,1212)	1	<p>When set, this Flag indicates that an inconsistency within the Directory or between the Directory and the Files of the File-set may exist. Potential recovery actions are implementation specific and are beyond the scope of this Standard. Enumerated Values:</p> <p>0000H: no known inconsistencies FFFFH: the FSR or FSU shall assume that inconsistencies are present</p> <p>This flag shall be set by implementations before a File-set update which, if interrupted, may result in an inconsistent File-set.</p> <p>NOTE: There may be error conditions where an inconsistency is present but this flag is not be set. They may also be conditions where no inconsistencies are present but the flag is set.</p>
4	Directory Record Sequence	(0004,1220)	2	<p>Sequence of zero or more repeating Items where each Item contains a Directory Record by including the Directory Elements from (0004,1400) to (0004,1511) and Record selection Keys as defined below (marked with a >).</p> <p>A zero length Value indicates that no Directory Records are contained in the Root Directory Entity.</p>
6	>Offset of the Next Directory Record	(0004,1400)	1C	<p>Offset of the first byte (of the Item Data Element) of the next Directory Record of the same Directory Entity. This Offset is an unsigned integer representing a number of bytes starting with the first byte of the File Meta-information. A zero offset shall be used to mean that there is no other Directory Record in this Directory Entity.</p> <p>Required if the Directory Record Sequence (0004,1220) is not zero length.</p> <p>This Offset may be used to keep an inactive Record (0004,1410) chained with the next Directory Record of the same Directory Entity.</p> <p>NOTE: This offset includes the File Preamble and the DICM Prefix.</p>
8				

2	>Record In-use Flag	(0004,1410)	1C	<p>This flag facilitates the deletion of referenced files.</p> <p>Enumerated Values: FFFFH = record is in use. 0000H = record is inactive. All attributes of an inactive Directory Record except (0004,1400) and (0004,1410) shall be ignored.</p> <p>Other Values are reserved and shall not be set by File-set Creators, but if present shall be interpreted as FFFFH by File-set Readers or Updaters.</p> <p>Required if the Directory Record Sequence (0004,1220) is not zero length.</p> <p>If a Directory Record is changed from in use to inactive, the FSU shall ensure that all Directory Records of referenced lower-level Directory Entities are changed to inactive.</p>
4 6	>Offset of Referenced Lower-Level Directory Entity	(0004,1420)	1C	<p>Offset of the first byte (of the Item Data Element) of the first Directory Record of the Referenced Lower Level Directory Entity. This Offset is a number of bytes starting with the first byte of the File Meta Information. Required if the Directory Record Sequence (0004,1220) is not zero length. When no lower-level Directory Entity (containing at least one Directory Record) is referenced, this Attribute shall have a Value of 00000000H.</p> <p>NOTE: This offset includes the File Preamble and the DICM Prefix.</p>
8	>Directory Record Type	(0004,1430)	1C	<p>Defines a specialized type of Directory Record by reference to its position in the Media Storage Directory Information Model (see Section B.X.4).</p> <p>Required if the Directory Record Sequence (0004,1220) is not zero length.</p> <p>Enumerated Values (see Section B.X.5): PATIENT STUDY SERIES IMAGE OVERLAY MODALITY LUT VOI LUT CURVE TOPIC VISIT RESULTS INTERPRETATION STUDY COMPONENT PRINT QUEUE FILM SESSION FILM BOX IMAGE BOX PRIVATE = Privately defined record hierarchy position. Type shall be defined by Private Record UID (0004,1432).</p> <p>MRDR = Special Directory Record which allows indirect reference to a File by multiple Directory Records. Instead of directly referencing a File by its Referenced File ID (0004,1500), a Directory Record of any of the Types define above (except MRDR) may reference a Multi-Referenced File Directory Record which in turn will reference the File by its File ID.</p>

2	>Private Record UID	(0004,1432)	1C	Required if the Directory Record Type (0004,1430) is of Value PRIVATE. This UID is used to define a non-standard type of Directory Record by reference to its position in a private extension to the Basic Directory IOD Information Model (see Section B.X.5). This UID shall be registered according to the procedures defined in PS 3.5 of the DICOM Standard. Its meaning may or may not be specified in a Conformance Statement.
4	>Referenced File ID	(0004,1500)	1C	<p>A Multiple Value (See PS 3.5) which represents the ordered components of the File ID containing a "referenced object" or Referenced SOP Instance. A maximum of 8 components, each from 1 to 8 characters shall be used (see Section 8.2).</p> <p>NOTE: The Referenced File ID provides the means to "locate" the File through the DICOM File Service provided by the Media Format Layer.</p> <p>All referenced Files shall be with the File-set to which the Directory belongs. Any File within the File-set (to which the Directory belongs) shall be referenced by at most one Directory Record.</p> <p>When the Directory Record does not reference any SOP Instance this attribute shall not be present.</p> <p>To reference a single File by more than one Directory Record, a special Directory Record of Directory Record Type (0004,1430) MRDR is used. The Referenced File ID (0004,1500) shall be absent and the MRDR Directory Record Offset (0004,1504) shall be used to reference the MRDR which indirectly references the File.</p>
6	>MRDR Directory Record Offset	(0004,1504)	1C	<p>Offset of the first byte (of the Item Data Element) of the Multi-Referenced File Directory Record. This Offset is a number of bytes starting with the first byte of the File Meta Information.</p> <p>When the Directory Record does not reference any SOP Instance this attribute shall not be present.</p> <p>Required if the Directory Record indirectly references a SOP Instance by a MRDR. Shall not be present if the Referenced File ID (0004,1500) is used for direct reference. Shall not be present in a Multi-Referenced File Directory Record.</p> <p>NOTE: This offset includes the File Preamble and the DICM Prefix.</p>

2	>Referenced SOP Class UID in File	(0004,1510)	1C	Unique ID for the SOP Class related to the IOD stored in the referenced File. This UID shall be present whether the File is referenced directly by Referenced File ID (0004,1500) or indirectly by an MRDR Directory Record Offset (0004,1504). Required only if the Directory Record references a SOP Instance. Shall not be used in a Multi-Referenced File Directory Record.
4 6	>Referenced SOP Instance UID in File	(0004,1511)	1C	Unique Identifier for the SOP Instance related to the IOD stored in the referenced file. This UID shall be present whether the File is referenced directly by Referenced File ID (0004,1500) or indirectly by an MRDR Directory Record Offset. Required only if the Directory Record references a SOP Instance. Shall not be used in a Multi-Referenced File Directory Record.
8	>Referenced Transfer Syntax UID in File	(0004,1512)	1C	Unique Identifier for the Transfer Syntax used to encode the IOD stored in the referenced file. This UID shall be present whether the File is referenced directly by Referenced File ID (0004,1500) or indirectly by an MRDR Directory Record Offset. Required only if the Directory Record references a SOP Instance. Shall not be used in a Multi-Referenced File Directory Record.
10	>Record Selection Keys	See B.X.5	See B.X.5	A number of DICOM Data Elements which contain specific keys defined for each type of Directory Record (0004,1430) defined in Section B.X.5.

B.X.4 Basic Directory IOD Information Model

The Basic Directory IOD Information Model defines the relationship between the various types of Directory Records which may be used in constructing DICOM Directories. This model is based on the DICOM Application Model defined in this part of the DICOM Standard. Entities in this Model correspond to Directory Records (DR). These are shown as rectangular boxes. Each Directory Record in this model is part of a Directory Entity (not shown except for the Root Entity) which is referenced by a Directory Record of a higher-level Directory Entity (e.g., a Study Directory Record references a Directory Entity which includes Directory Records describing the content of the Study).

Each Directory Record has a number of mandatory and optional keys which are not shown on this model. They are defined in Section B.X.5. Conventions used are those used by this part of the DICOM Standard. The model is depicted as an entity/relationship model in Figure B.X.4-1. These Directory Record relationships are fully specified in Table B.X.4-2.

Figure B.X.4-1 Basic Directory IOD Information Model

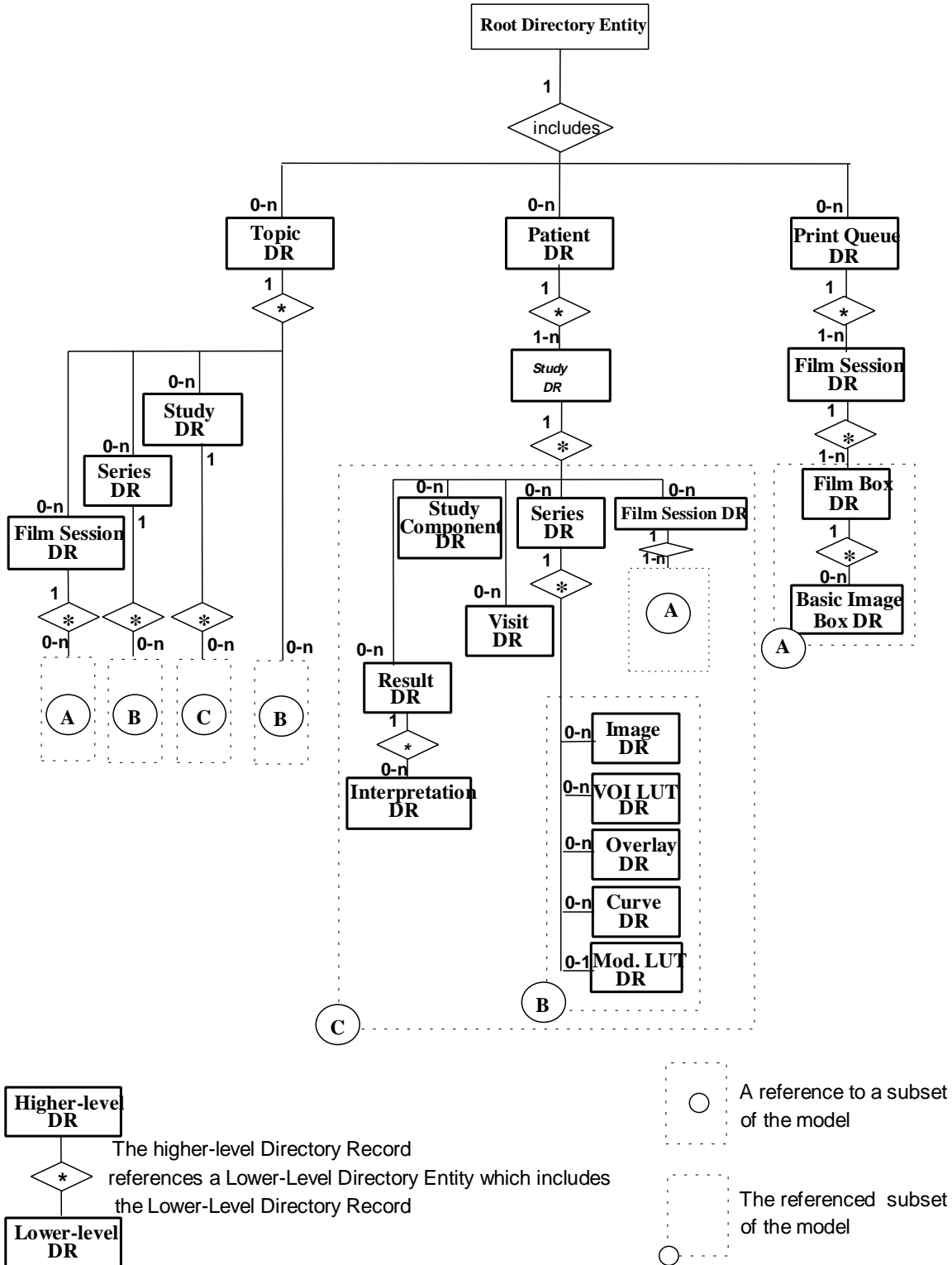


Table B.X.4-2 Relationship between Directory Records

Directory Record Type	Section	Directory Record Types which may be included in the next lower-level directory Entity
(Root Directory Entity)	-	PATIENT, TOPIC, PRINT QUEUE, PRIVATE
PATIENT	B.X.5.1	STUDY, PRIVATE
STUDY	B.X.5.2	SERIES, VISIT, RESULTS, STUDY COMPONENT FILM SESSION, PRIVATE
SERIES	B.X.5.3	IMAGE, OVERLAY, MODALITY LUT, VOI LUT, CURVE, PRIVATE
IMAGE	B.X.5.4	PRIVATE
OVERLAY	B.X.5.5	PRIVATE
MODALITY LUT	B.X.5.6	PRIVATE
VOI LUT	B.X.5.7	PRIVATE
CURVE	B.X.5.8	PRIVATE
TOPIC	B.X.5.9	STUDY, SERIES, IMAGE, OVERLAY, MODALITY LUT, VOI LUT, CURVE, FILM SESSION, PRIVATE
VISIT	B.X.5.10	PRIVATE
RESULTS	B.X.5.11	INTERPRETATION, PRIVATE
INTERPRETATION	B.X.5.12	PRIVATE
STUDY COMPONENT	B.X.5.13	PRIVATE
PRINT QUEUE	B.X.5.14	FILM SESSION, PRIVATE
FILM SESSION	B.X.5.15	FILM BOX, PRIVATE
FILM BOX	B.X.5.16	BASIC IMAGE BOX, PRIVATE
BASIC IMAGE BOX	B.X.5.17	PRIVATE
PRIVATE	B.X.6.1	PRIVATE, (any of the above as privately defined)
MRDR	B.X.6.2	(Not applicable)

B.X.5 Definition of Specific Directory Records

The following Sections specify a number of Directory Records which were introduced by the Basic Directory IOD Information Model presented in Section B.X.4. For each one, it identifies the SOP Classes which may be referenced and the related mandatory keys. Keys are assigned a Type designation which indicates if it is required for all Media Storage Operations of the Directory (See Section 5, Conventions).

Type 2 and Type 3 Keys may be changed to Type 1 and Type 2 or 3 respectively by Application Profiles defined in PS 3.11 of the DICOM standard. Keys based on Private Data Elements, or Private Keys may also be used in addition to Standard defined Keys. However such Private keys may be ignored by any File-set Reader or Updater.

B.X.5.1 Patient Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "PATIENT". Table B.X.5.1-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Patient IOD or the Patient IE of Image IODs. This Directory Record shall be used to reference a Detached Patient Management SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.1-1 Patient Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Patient's Name	(0010,0010)	2
Patient ID	(0010,0020)	1
Any Attribute of the Patient IOD or Patient IE Modules		3

For a given File-set, the Patient ID shall be unique. This means that it shall not appear in different Patient Directory Records.

B.X.5.2 Study Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "STUDY". Table B.X.5.2-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Study IOD or the Study IE of Image IODs. This Directory Record shall be used to reference a Detached Study Management SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.2-1 Study Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Study Date	(0008,0020)	1
Study Time	(0008,0030)	1
Study Description	(0008,1030)	2
Study Instance UID	(0020,000D)	1C (Required only if (0004,1511) is absent. See Note)

Study ID	(0020,0010)	1
Accession Number	(0008,0050)	2
Any Attribute of the Study IOD or Study IE Modules		3

NOTE: The Study Instance UID shall be present as a mandatory key only if no file is referenced by this Directory Record. In the case where this Directory Record references a file, the Directory Record contains in the Referenced SOP Instance UID in File (0004,1511). In this case (0004,1511) may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1) and need not be duplicated.

B.X.5.3 Series Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "SERIES". Table B.X.5.3-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Series IE and Equipment IE of Image IODs. This type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.3-1 Series Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Modality	(0008,0060)	1
Series Instance UID	(0020,000E)	1
Series Number	(0020,0011)	1
Icon Image Sequence (This Icon Image is representative of the Series. It may or may not correspond to one of the images of the Series.)	(0088,0200)	3
> Image Pixel Module		(See Section B.X.7 of this Part)
Any Attribute of the Series IE Modules		3

B.X.5.4 Image Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "IMAGE". Table B.X.5.4-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Image IE of Image IODs. This Directory Record shall be used to reference an Image SOP Instance. This type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.4-1 Image Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Image Number	(0020,0013)	1
Icon Image Sequence (This Icon Image is representative of the Image.)	(0088,0200)	3
> Image Pixel Module		(See Section B.X.7 of this Part)
Any Attribute of the Image IE Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.5 Standalone Overlay Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "OVERLAY". Table B.X.5.5-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Overlay IE of Image IODs. This Directory Record shall be used to reference a Standalone Overlay Image SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.5-1 Overlay Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Overlay Number	(0020,0022)	1
Icon Image Sequence	(0088,0200)	3
> Image Pixel Module		(See Section B.X.7 of this Part)
Any Attribute of the Overlay IE Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.6 Standalone Modality LUT Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "MODALITY LUT". Table B.X.5.6-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Modality LUT IE of Image IODs. This Directory Record shall be used to reference a Standalone Modality LUT SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.6-1 Modality LUT Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Lookup table Number	(0020,0026)	1
Any Attribute of the Modality LUT IE Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.7 Standalone VOI LUT Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "VOI LUT". Table B.X.5.7-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the VOI LUT IE of Image IODs. This Directory Record shall be used to reference a Standalone VOI LUT SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.7-1 VOI LUT Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Lookup Table Number	(0020,0026)	1
Any Attribute of the VOI LUT IE Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.8 Standalone Curve Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "CURVE". Table B.X.5.8-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Curve IE of Image IODs. This Directory Record shall be used to reference a Standalone Curve SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.8-1 Curve Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Curve Number	(0020,0024)	1
Any Attribute of the Curve IE Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.9 Topic Directory Record Definition

The Topic Directory Record is intended to collect a set of subordinate Directory Records. It uses simple textual descriptions as keys. The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "TOPIC". Table B.X.5.9-1 lists the set of keys with their associated Types for such a Directory Record Type. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.9-1 Topic Keys

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used
Topic Title	(0088,0904)	1	Text title for the topic addressed by this Directory Record
Topic Subject	(0088,0906)	2	Short Text description of the subject addressed by this topic
Topic Author	(0088,0910)	2	Name of the author or creator of this topic
Topic Key Words	(0088,0912)	2	A multiple Value field including from 1 to 32 key-words related to the topic.

NOTE: For more complex Directory Records with additional keys, a PRIVATE Directory Record is suggested rather than a Topic Directory Record.

B.X.5.10 Visit Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "VISIT". Table B.X.5.10-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Visit IOD. This Directory Record shall be used to reference a Detached Visit Management SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.10-1 Visit Keys

Key	Tag	Type
Admitting Date	(0038,0020)	2
Admission ID	(0038,0010)	2
Institution Name	(0008,0080)	2
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Any Attribute of the Visit IOD Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.11 Results Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "RESULTS". Table B.X.5.11-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Results IOD. This Directory Record shall be used to reference a Detached Results Management SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.11-1 Result Keys

Key	Tag	Type
Results ID	(4008,0040)	2
Instance Creation date (Results)	(0008,0012)	2
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Any Attribute of the Results IOD Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.12 Interpretation Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "INTERPRETATION". Table B.X.5.12-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Interpretation IOD. This Directory Record shall be used to reference an Interpretation SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.12-1 Interpretation Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Interpretation Transcription Date	(4008,0108)	1
Interpretation Author	(4008,010C)	2
Interpretation Diagnosis Description	(4008,0115)	2
Interpretation Diagnosis Codes Sequence	(4008,0117)	2
> Code Value	(0008,0100)	1C Required if (4008,0117) is present
> Coding Scheme Designator	(0008,0102)	1C Required if (4008,0117) is present
> Code Meaning	(0008,0104)	1C Required if (4008,0117) is present
Interpretation ID	(4008,0200)	1
Interpretation Type ID	(4008,0210)	2
Interpretation Status ID	(4008,0212)	2
Any Attribute of Interpretation related Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.13 Study Component Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "STUDY COMPONENT". Table B.X.5.13-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Study Component IOD. This Directory Record shall be used to reference a Study Component SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.13-1 Study Component Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)

Modality	(0008,0060)	1
Study Description	(0008,1030)	2
Procedure Code Sequence	(0008,1032)	1
> Code Value	(0008,0100)	1C Required if (0008,1032) is present
> Coding Scheme Designator	(0008,0102)	1C Required if (0008,1032) is present
> Code Meaning	(0008,0104)	1C Required if (0008,1032) is present
Attending Physician's Name	(0008,1050)	2
Any Attribute of Study Component Modules		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.14 Print Queue Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "PRINT QUEUE". Table B.X.5.14-1 lists the set of keys with their associated Types for such a Directory Record Type. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.14-1 Print Queue Keys

Key	Tag	Type	Attribute Description
Print Queue ID	(2110,0099)	1	User defined identifier for a Print Queue.
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used
Printer Name	(2110,0030)	2	User defined name identifying the printer

B.X.5.15 Film Session Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "FILM SESSION". Table B.X.5.15-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Film Session and Print Job IOD. This Directory Record shall be used to reference a Film Session SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.15-1 Film Session Keys

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used
Film_session_label	(2000,0050)	2	Human readable label that identifies the Film session

Execution Status	(2100,0020)	1C	Execution Status of the printing of the Film Session; Enumerated Values: PENDING = to be printed NOTE: Printing of a Film Session with a PENDING Status may not have been attempted yet, or may have already been attempted but was unsuccessful. DONE = has been successfully printed Required if the Film Session Directory Record is associated with a Print queue.
Any Attribute of the Film Session IOD Modules		3	

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.16 Film Box Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "FILM BOX". Table B.X.5.16-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Basic Film Box IOD. This Directory Record shall be used to reference a Basic Film Box SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.16-1 Basic Film Box Keys

Key	Tag	Type	Attribute Description
Specific Character Set	(0008,0005)	1C	Required if an extended or replacement character set is used in one of the keys
Execution Status	(2100,0020)	1C	Execution Status of the printing of the Film Box; Enumerated Values: PENDING = to be printed NOTE: Printing of a Film Box with a PENDING Status may not have been attempted yet, or may have already been attempted but was unsuccessful. DONE = has been successfully printed Required if the Film Box Directory Record is associated with a Print queue.
Any Attribute of Basic Film Box Presentation Module		3	3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.5.17 Basic Image Box Directory Record Definition

The Directory Record is based on the specification of Section B.X.3. It is identified by a Directory Record Type of Value "BASIC IMAGE BOX". Table B.X.5.17-1 lists the set of keys with their associated Types for such a Directory Record Type. The description of these keys may be found in the Modules related to the Basic Greyscale Image Box IOD or the Basic Color Image Box IOD. This Directory Record shall be used to reference a Basic Greyscale Image Box SOP Instance or a Basic Color Image Box SOP Instance. This Type of Directory Record may reference a Lower-Level Directory Entity which includes one or more Directory Records as defined in Table B.X.4-2.

Table B.X.5.17-1 Basic Image Box Keys

Key	Tag	Type
Specific Character Set	(0008,0005)	1C (Required if an extended or replacement character set is used in one of the keys)
Image Position	(2020,0010)	1
Any Attribute of Basic Image Box Presentation Module		3

NOTE: Because (0004,1511) Referenced SOP Instance UID in File may be used as a "pseudo" Directory Record Key (See Table B.X.3.2.2-1), it is not duplicated in this list of keys.

B.X.6 Special Directory Records

B.X.6.1 Private Directory Record Definition

Private Directory Records may also be used in addition to Standard defined Directory Records. Such Private Records shall follow the specification of Sections B.X.2 and B.X.3. In addition, if created by File-set Creators they shall be proper extensions to the DICOM Basic Directory IOD Information Model specified in Section B.X.4. By proper extensions it is meant that any File-set Creator creating private Directory Records shall still meet the DICOM PS 3.10 conformance requirements. Thus a File-set Reader or File-set Updater which chooses to ignore such privately defined Directory Records will find a conformant Directory.

B.X.6.2 Multi-Referenced File Directory Record Definition

This Directory Record is based on the specification of Section B.X.3. The Multi-Referenced File Directory Record (MRDR) is a special type of Directory Record which allows indirect reference to a File by multiple Directory Records. Such a Directory Record facilitates the management (deletion/update) of referenced Files by keeping an explicit count of the number of references. Instead of directly referencing a File by its Referenced File ID, a Directory Record of any of the Types define above (except the Multi-Referenced File Directory Record itself) may reference the Multi-Referenced File Directory Record which in turn will reference the File by its File ID. This Type of Directory Record shall not reference a Lower-Level Directory Entity.

The following restrictions apply to this Directory Record:

- Offset of the Next Directory Record shall be set to 00000000H;
- Offset of Referenced Lower-Level Directory Entity shall be set to 00000000H;
- Directory Record Type shall be set to MRDR;
- Referenced File ID shall be set to the File ID of the Multi-Referenced File;
- Referenced SOP Class UID shall be absent;
- Referenced SOP Instance UID shall be absent.

One additional attribute is defined in Table 5.19-1 and shall be included as a "pseudo" Key.

Table B.X.5.19-1 Multi-Referenced File Keys

Key	Tag	Type	Attribute Description
Number of References	(0004,1600)	1	<p>Number of References made by other Directory Records to this MDRD Directory Record. When set to 0000H the MRDR record is inactive. The Referenced File ID (0004,1610) value of the MRDR record shall be considered as invalid and ignored.</p> <p>Number of References (0004,1600) shall be reduced by one when a Directory Record of any Type (referencing this Multi-Referenced File Directory Record) is either deleted or when its Record In Use Flag (0004,1410) set to inactive. When a Directory Record of any Type (referencing this Multi-Referenced File Directory Record) is added, the Number of References (0004,1600) shall be increased by one.</p> <p>NOTE: If the Number of References becomes zero, it is an implementation decision whether the MRDR Directory Record is deleted or left inactive and if the Multi-Referenced File is deleted.</p>

B.X.7 Icon Image Key Definition

An Icon Image may be used as a key representative of an Image, Series or Overlay in a corresponding Directory Record to select one or more Image, Series or Overlay among several of them. It is based on the general purpose Image Pixel Module (See Annex C).

The Icon Image Key corresponds to Data Element (0088,0200). It is defined as a Sequence which contains a single Item encapsulating the Data Set made of the Data Elements of the Icon Image. The

Data Elements are defined by the Image Pixel Module.

The Image Pixel Module usage is restricted in a few areas to facilitate general use in Directory Record across various modality environments. These restrictions are:

1. Only monochrome and palette color images shall be used. Samples per Pixel (0028,0002) shall have a Value of 1, Photometric Interpretation (0028,0004) shall have a Value of either MONOCHROME 1, MONOCHROME 2 or PALETTE COLOR, Planar Configuration (0028,0006) shall not be present;

NOTE: True color icon images are not supported. This is due to the fact that the reduced size of the Icon Image makes the quality of a palette color image (with 256 colors) sufficient in most cases. This simplifies the handling of Icon Images by File-set Readers and File-set Updaters.

2. If an FSR/FSU supports Icons (i.e. does not ignore them) then it shall support at least a maximum size of 64 by 64 Icons. An FSC may write Icons of any size. Icons larger than 64 by 64 may be ignored by FSRs and FSUs unless specialized by Application Profiles;
3. Pixel samples have a Value of either 1 or 8 for Bits Allocated (0028,0100) and Bits Stored (0028,0101). High Bit (0028,0102) shall have a Value of one less than the Value used in Bit Stored;
4. Pixel Representation (0028,0103) shall used an unsigned integer representation (Value 0000H);
5. Pixel Aspect Ratio (0028,0034) shall have a Value of 1:1;
6. If a Palette Color lookup Table is used, an 8 Bit Allocated (0028,0100) shall be used.

Annex A (Informative) - Index to Attribute Tags

2									
4									
6	(0001,xxxx)	19							
	(0002,0000)	18							
8	(0002,0001)	18							
	(0002,0002)	18							
10	(0002,0003)	18							
	(0002,0010)	19							
12	(0002,0012)	19							
	(0002,0013)	19							
14	(0002,0016)	19							
	(0002,0100)	19							
16	(0002,0102)	19							
	(0002,xxxx)	19							
18	(0003,xxxx)	19							
	(0004,1130)	44							
20	(0004,1141)	45							
	(0004,1142)	45							
22	(0004,1200)	45							
	(0004,1202)	45							
24	(0004,1212)	46							
	(0004,1220)	46	47						
26	(0004,1400)	46	47						
	(0004,1410)	46	47	62					
28	(0004,1420)	47							
	(0004,1430)	47	48	49					
30	(0004,1432)	47	48						
	(0004,1500)	47	48	49					
32	(0004,1504)	48	49						
	(0004,1510)	49							
34	(0004,1511)	46	49	52	53	54	55	56	57
		58	59	60	61				
36	(0004,1512)	49							
	(0004,1600)	62							
38	(0004,1610)	62							
	(0004,xxxx)	19							
40	(0005,xxxx)	19							
	(0006,eeee)	19							
42	(0007,eeee)	19							
	(0008,0005)	52	53	54	55	56	57	58	59
44		60	61						

	(0008,0012)	57		
2	(0008,0020)	52		
	(0008,0030)	52		
4	(0008,0050)	53		
	(0008,0060)	53	59	
6	(0008,0080)	57		
	(0008,0100)	58	59	
8	(0008,0102)	58	59	
	(0008,0104)	58	59	
10	(0008,1030)	52	59	
	(0008,1032)	59		
12	(0008,1050)	59		
	(0010,0010)	52		
14	(0010,0020)	52		
	(0020,000D)	52		
16	(0020,000E)	53		
	(0020,0010)	53		
18	(0020,0011)	53		
	(0020,0013)	54		
20	(0020,0022)	54		
	(0020,0024)	56		
22	(0020,0026)	55		
	(0028,0002)	63		
24	(0028,0004)	63		
	(0028,0006)	63		
26	(0028,0034)	63		
	(0028,0100)	63		
28	(0028,0101)	63		
	(0028,0102)	63		
30	(0028,0103)	63		
	(0038,0010)	57		
32	(0038,0020)	57		
	(0088,0200)	53	54	62
34	(0088,0904)	56		
	(0088,0906)	56		
36	(0088,0910)	56		
	(0088,0912)	56		
38	(2000,0050)	59		
	(2020,0010)	61		
40	(2100,0020)	60		
	(2110,0030)	59		
42	(2110,0099)	59		
	(4008,0040)	57		
44	(4008,0108)	58		
	(4008,010C)	58		

	(4008,0115)	58
2	(4008,0117)	58
	(4008,0200)	58
4	(4008,0210)	58
	(4008,0212)	58
6	(FFFC,FFFC)	20
	(gggg,eeee)	10
8		

ACC-ACR-NEMA

**Digital Imaging and Communications
in Medicine (DICOM)**

**Part 4 Addendum
Media Storage Service Class
For Media Interchange**

2 **Add to PS 3.4 the following Annex X:**

3 **Annex X (Normative) - Media Storage Service Class**

4 **X.1 Overview**

6 **X.1.1 Scope**

8 The Media Storage Service Class defines an application-level class-of-service which facilitates the simple transfer of images and associated information between DICOM AEs by means of Storage Media. It supports:

- 10 1. The Interchange of images and a wide range of associated information. This is called the Interchange Option of the Media Storage Service Class;
- 12 2. The Storage of Images organized in Filming Sessions to ensure in an off-line manner their transfer for hardcopy printing. This is called the Print Option of the Media Storage Service Class;
- 14 3. The combined use of the Interchange Option and of the Print Option as introduced
- 16 in 1 and 2 above.

18 **X.1.2 Service Definition**

20 DICOM AEs implement a SOP Class of the Interchange Option of the Media Storage Service Class by supporting one or more roles among the three roles FSC, FSR or FSU. DICOM AEs implement a SOP Class of the Print Option of the Media Storage Service Class by supporting one or more roles among the two roles FSC or FSU. SOP Classes of the Media Storage Service Class (either Options) are implemented using the Media Storage Operations (M-WRITE, M-READ, M-DELETE, M-INQUIRE FILE-SET and M-INQUIRE FILE). The services provided by these Operations are defined in PS 3.10 of the DICOM standard.

26 **X.2 Behavior**

28 This Section discusses the FSC, FSR and FSU behavior for SOP Classes of the Media Storage Service Class.

30 **X.2.1 Behavior of an FSC**

32 The FSC shall be able to create a DICOMDIR File containing the Media Storage Directory SOP Class for the created File-set and create zero or more Files belonging to the File-set by invoking M-WRITE Operations with SOP Instances which meet the requirements of the corresponding IOD. It is the responsibility of the FSC to ensure that the M-WRITE results in the creation of a correctly formatted DICOM File. The manner in which this is achieved is beyond the scope of the Standard.

36

2 The FSC shall support the Media Storage Operation M-INQUIRE FILE-SET and may optionally support the M-INQUIRE FILE.

4 For the Print Option the following specifically applies:

- 6 - An FSC requests that a Film Session be printed by an FSU by placing a Film Session Directory Record in a Print Queue Directory Entity and setting the Execution Status (2100,0020) of the Film Session Directory Record to Pending;
- 8 - For a Film Session which is requested to be printed, only Film Boxes with an Execution Status (2100,0020) of Pending are requested to be printed.

10 **X.2.2 Behavior of an FSR**

12 This behavior applies only to the Interchange Option of the Media Storage Service Class. The FSR shall be able to recognize a File-set and the corresponding DICOMDIR containing the Media Storage Directory SOP Class. A valid File-set may contain only a DICOMDIR and no other files. If a File-set contains other files with stored SOP Instance, the FSR shall be capable of invoking M-READ Operations to access the content of the Files of the File-set. The manner in which this is achieved is beyond the scope of the Standard.

18 The FSR shall support the Media Storage Operation M-INQUIRE FILE and may optionally support the M-INQUIRE FILE-SET.

22 **X.2.3 Behavior of an FSU**

24 The FSU shall be able to recognize a File-set and the corresponding DICOMDIR containing the Media Storage Directory SOP Class. A valid File-set may contain only a DICOMDIR and no other files. If a File-set contains other files with stored SOP Instances, the FSU shall be capable of invoking M-READ Operations to access the content of the Files of the File-set. The manner in which this is achieved is beyond the scope of the Standard.

28 The FSU shall support the Media Storage Operation M-INQUIRE FILE and the M-INQUIRE FILE-SET.

32 The FSU shall be able to create one or more new Files belonging to the File-set by invoking M-WRITE Operations with SOP Instances which meet the requirements of the corresponding IOD. It is the responsibility of the FSU to ensure that the M-WRITE results in the creation of a correctly formatted DICOM File. The manner in which this is achieved is beyond the scope of the Standard. The FSU shall be able to update the contents of the DICOMDIR File by using M-DELETE and or M-WRITE Operations.

38 For the Print Option the following specifically applies:

- 40 a) Only Film Sessions with a Film Session Directory Record present in a Print Queue

2 Directory Entity with an Execution Status (2100,0020) of Pending are candidates to
be printed;

- 4 b) For a Film Session which is candidate for printing, Film Boxes with an Execution
Status (2100,0020) of Pending are candidates for being printed;

6 NOTE: The behavior of an FSU with respect to Film Sessions and Film Boxes with an Execution Status
(2100,0020) of Done, is beyond the scope of the DICOM Standard. They may or may not be printed
by the FSU;

- 8 c) Following the successful printing of a Film Box, the FSU supporting the Print Option
shall change the Execution Status (2100,0020) of the corresponding Film Box
10 Directory Record to Done. Once all the Film Boxes of a Film Session have been
successfully printed by the FSU, the Film Session Directory Record Execution Status
12 shall updated to Done. It is beyond the scope of the Print Option of this Service
Class to decide whether or not the Film Session, related Film Boxes Directory
14 Records, referenced Film Session, Film Box and Image Box SOP Instances may be
deleted from the File-set by the FSU;

- 16 d) Following a failure to print one or more Film Boxes from a Film Session, the FSU
shall leave the status of the corresponding Film Box Directory Record as Pending.
18 While there are Pending Film Boxes in a Film Session, the Execution Status of the
Film session shall remain Pending. It is beyond the scope of the Print Option of this
20 Service Class to decide what recovery action may be taken following the failure of
printing a Film Box.

22 NOTE: In the case of such failure it is recommended that the Film Session and related Film Box Directory
Records as well as referenced Film Session, Film Box and Image Box SOP Instances not be deleted
24 from the File-set by the FSU. The Print Option of this Service Class does not include the use of
the M-DELETE Operation for Files except for updating the DICOMDIR File. The Interchange
26 Option of the Media Storage Service Class with an FSU Role is intended to be used for such a
function.

28 X.3 Conformance

30 X.3.1 Conformance as an FSC

32 An implementation which conforms to one of the SOP Classes of the Media Storage Service
Class:

- 34 a) shall meet the requirements specified in Section X.2.1;
- b) shall meet the requirements specified in PS 3.10 of the DICOM standard;
- 36 c) shall perform M-WRITE Operations according to the SOP Class specification
identified by the SOP Class UID in the Meta File Information;
- 38 d) shall support the Media Storage Directory SOP Class (stored in the DICOMDIR File).
If it supports only the Interchange Option, the directory may contain no Directory

Information Module. If it supports the Print Option the directory shall contain a Directory Information Module with appropriate Directory Records (Print Queue, Film Session, Film Box, and Image Box.);

- e) may create DICOMDIR Files containing the Media Storage Directory SOP Class with Directory Records making multiple references to a File through an MRDR Directory Records.

X.3.2 Conformance as an FSR

An implementation which conforms to one of the SOP Classes of the Media Storage Service Class with the Interchange Option:

- a) shall meet the requirements specified in Section X.2.2;
- b) shall meet the requirements specified in PS 3.10 of the DICOM standard;
- c) shall perform M-READ Operations according to the SOP Class specification identified by the SOP Class UID in the Meta File Information. M-READ of non-supported SOP Classes shall simply result in ignoring such stored Data Sets;
- d) shall read DICOMDIR Files containing the Media Storage Directory SOP Class with Directory Records making multiple references to Files through an MRDR Directory Record.
- e) shall read DICOMDIR Files without a Directory Information Module or with a Directory Information Module including Directory Records of a Type not supported by the implementation.

X.3.3 Conformance as an FSU

An implementation which conforms to one of the SOP Classes of the Media Storage Service Class:

- a) shall meet the requirements specified in Section X.2.3;
- b) shall meet the requirements specified in PS 3.10 of the DICOM standard;
- c) shall perform M-READ Operations according to the SOP Class specification identified by the SOP Class UID in the Meta File Information. M-READ of unsupported SOP Classes shall simply result in ignoring such stored Data Sets;
- d) shall perform M-WRITE Operations according to the SOP Class specification identified by the SOP Class UID in the Meta File Information;
- e) shall support the Media Storage Directory SOP Class (stored in the DICOMDIR File). Directories containing a Directory Information Module shall be updated by an FSU. Directories containing no Directory Information Module shall not be updated by an

FSU;

- f) shall read DICOMDIR Files containing the Media Storage Directory SOP Class with Directory Records making multiple references to Files through an MRDR Directory Record;
- g) may optionally update DICOMDIR Files containing the Media Storage Directory SOP Class by creating Directory Records, utilizing MRDR Directory Records where multiple references to Files are needed.
- h) shall read DICOMDIR Files without a Directory Information Module or with a Directory Information Module including Directory Records of a Type not supported by the implementation.

X.3.4 Conformance Statement Requirements

An implementation of the Media Storage Service Class may support one or more Roles and related Options as specified in Table X.3.2-1. In addition, the implementation may conform to one or more of the SOP Classes of the Media Storage Service Class defined in Section X.4. The Conformance Statement shall be in the format defined by PS 3.2 of the DICOM Standard.

Table X.3.2-1 Allowed Combinations of Roles and Options

Options		Roles	FSR	FSC	FSU
Interchange Option	With a Directory Information Module		Allowed	Allowed	Allowed Directory shall be updated
	With no Directory Information Module		Allowed	Allowed	Allowed Directory shall not be updated
Print Option	With a Directory Information Module		Not Allowed	Allowed	Allowed Directory shall be updated
	With no Directory Information Module		Not Allowed	Not Allowed	Not Allowed

The following aspects shall be documented in the Conformance Statement of any implementation claiming conformance to one of the Media Storage SOP Classes:

- the subset of the Basic Directory Information Object Model supported;
- which of the Service Class Options are supported: Interchange Option or Print Option or both;
- for the Interchange Option, whether the Directory Information Module is present or absent.
- When the Directory Information Module is created or updated (Directory Information Module supported), the optional standard keys which may be included in Directory Records shall be documented. Private Keys and Private Records may also be documented;

X.3.5 Standard Extended, Specialized and Private Conformance

In addition to Standard Media Storage SOP Classes, implementations may support Standard Extended, Specialized and/or Private SOP Classes as defined by PS 3.2 of the DICOM Standard.

For all three types of SOP Classes, implementations shall be permitted to conform as an FSC, FSR, both or as an FSU. The Conformance Statement shall be in the format defined in PS 3.2 of the DICOM Standard.

X.4 Media Storage Standard SOP Classes

The SOP Classes in the Media Storage Service Class identify the Composite and Normalized IODs to be stored. The following Standard SOP Classes are identified in Table X.4-1

Table X.4-1 Media Storage Standard SOP Classes

SOP Class Name	SOP Class UID	IOD Specification
Media Storage Directory Storage	1.2.840.10008.1.3.10	IOD defined in PS 3.3
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	IOD defined in PS 3.3
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	IOD defined in PS 3.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3	IOD defined in PS 3.3
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	IOD defined in PS 3.3
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.5	IOD defined in PS 3.3
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6	IOD defined in PS 3.3
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	IOD defined in PS 3.3
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	IOD defined in PS 3.3
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9	IOD defined in PS 3.3

2	Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	IOD defined in PS 3.3
	Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	IOD defined in PS 3.3
4	X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	IOD defined in PS 3.3
6	X-ray RadioFluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	IOD defined in PS 3.3
8	X-ray Angiographic Bi-plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3	IOD defined in PS 3.3
10	Detached Patient Management Storage	1.2.840.10008.3.1.2.1.1	See N-GET attributes Section E.3.2.1
12	Detached Visit Management Storage	1.2.840.10008.3.1.2.2.1	See N-GET attributes Section E.4.2.1
14	Detached Study Management Storage	1.2.840.10008.3.1.2.3.1	See N-GET attributes Section F.3.2.1
16	Detached Study Component Management Storage	1.2.840.10008.3.1.2.3.2	See N-GET attributes Section F.4.2.1
18	Detached Results Management Storage	1.2.840.10008.3.1.2.5.1	See N-GET attributes Section G.3.2.1
20	Detached Interpretation Management Storage	1.2.840.10008.3.1.2.6.1	See N-GET attributes Section G.4.2.1
22	Basic Film Session Storage	1.2.840.10008.5.1.1.1	See N-CREATE attributes Section H.4.1.2.1
24	Basic Film Box Storage	1.2.840.10008.5.1.1.2	See N-CREATE attributes Section H.4.2.2.1
26	Basic Greyscale Image Box Storage	1.2.840.10008.5.1.1.4	See N-CREATE attributes Section H.4.3.1.2.1
28	Basic Color Image Box Storage	1.2.840.10008.5.1.1.4.1	See N-CREATE attributes Section H.4.3.2.2.1

NOTE: Except for the Media Storage Directory SOP Classes, the above listed Media Storage Standard SOP Classes are assigned the same UID Value as the corresponding network communication SOP Classes. This was done to simplify UID assignment. Although these SOP Classes are based on different Operations, the context of their usage should unambiguously distinguish a Media Storage SOP Class from a Network communication SOP Class.

ACC-ACR-NEMA

Digital Imaging and Communications in Medicine (DICOM)

Part 6 Addendum Basic Directory Data Dictionary

Create a Section 7 of PS 3.6**7. Registry of DICOM File Meta Elements**

This Section specifies the File Meta Elements needed to support the formatting of the File Meta Information of the DICOM File Format (See PS 3.10).

Tag	Name	VR	VM
(0002,0000)	Group Length	UL	1
(0002,0001)	File Meta Information Version	OB	1
(0002,0002)	Media Stored SOP Class UID	UI	1
(0002,0003)	Media Stored SOP Instance UID	UI	1
(0002,0010)	Transfer Syntax UID	UI	1
(0002,0012)	Implementation Class UID	UI	1
(0002,0013)	Implementation Version Name	SH	1
(0002,0016)	Source Application Entity Title	AE	1
(0002,0100)	Private Information Creator UID	UI	1
(0002,0102)	Private Information	OB	1

Add new Section 8 to PS 3.6**8. Registry of DICOM Directory Structuring Elements**

Tag	Name	VR	VM
(0004,1130)	File-set ID	CS	1
(0004,1141)	File-set Descriptor File ID	CS	1-8
(0004,1142)	Specific Character Set of File-set Descriptor File	CS	1
(0004,1200)	Offset of the First Directory Record of the Root Directory Entity	UL	1
(0004,1202)	Offset of the Last Directory Record of the Root Directory Entity	UL	1
(0004,1212)	File-set Consistency Flag	US	1
(0004,1220)	Directory Record Sequence	SQ	1
(0004,1400)	Offset of the Next Directory Record	UL	1
(0004,1410)	Record In-use Flag	US	1
(0004,1420)	Offset of Referenced Lower-Level Directory Entity	UL	1
(0004,1430)	Directory Record Type	CS	1
(0004,1432)	Private Record UID	UI	1
(0004,1500)	Referenced File ID	CS	1-8
(0004,1504)	Directory Record Offset	UL	1
(0004,1510)	Referenced SOP Class UID in File	UI	1
(0004,1511)	Referenced SOP Instance UID in File	UI	1
(0004,1512)	Referenced Transfer Syntax UID in File	UI	1

(0004,1600) Number of References UL 1

Add the following Data Elements to Section 6 of PS 3.6

Tag	Attribute Name	VR	VM
(0020,0026)	Lookup Table Number	US	1
(0088,0200)	Icon Image	SQ	1
(0088,0904)	Topic Title	LO	1
(0088,0906)	Topic Subject	ST	1
(0088,0910)	Topic Author	LO	1
(0088,0912)	Topic Key Words	LO	1-32
(2110,0099)	Print Queue ID	SH	1
(FFFC,FFFC)	Data Set Trailing Padding	OB	1

Add the following UIDs to Annex of PS 3.6

UID Value	UID NAME	UID TYPE	Part
1.2.840.10008.1.3.10	Media Storage Directory Storage	SOP Class	PS 3.3