Digital Imaging and Communications in Medicine (DICOM)

Supplement 153: Blu-ray Disc Media Application Profiles

DICOM Standards Committee, Working Group 5 Exchange Media

and Working Group 13 Visible Light

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Scope and Field of Application

New clinical applications have requirements for higher capacity media formats. This is true for general-purpose applications and is also especially important in the support of the High Definition Images and Video that is becoming more common for endoscope surgery. General (peripheral and neurological) surgery and diagnostic imaging, such as CT, MRI, similarly require significantly higher capacity than is afforded by DVD.

CHOICE OF A FILESYSTEM

All Blu-ray Disc™ media make use of the UDF file system. BD-RE as presently supported in the standard defines the use of UDF 2.5. BD-R as presently supported in the standard defines the use of UDF 2.6.

Note: "Blu-ray Disc", "Blu-ray" and the "Blu-ray Disc" logo are trademarks of the Blu-ray Disc Association.

CHOICE OF A PHYSICAL MEDIUM

It should be stressed that DICOM is not attempting to standardize an archive medium, only an interchange medium (though many applications typically write interchange media using the same physical drive and software as is used for writing single archival volumes for shelf management). It is, however, desirable that media chosen for interchange be resilient and non-volatile.

Note: For special applications or for severe environments a cartridge may be used.

FORM OF THIS SUPPLEMENT

This supplement defines the use of BD-RE and BD-R.

It specifies the use of the Universal Disk Format (UDF) 2.5 and 2.6.

Media Application Profiles are defined for General Purpose applications.

This Supplement makes changes to the following existing Parts of DICOM:

- PS 3.11 Addendum: Media Storage Application Profiles
- PS 3.12 Addendum: Media Formats and Physical Media for Data Interchange

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100 **Changes to NEMA Standards Publication PS 3.11-2009**

101 # Digital Imaging and Communications in Medicine (DICOM)

102 # Part 11: Media Storage Application Profiles

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PS 3.11: Modify Section 4 (Add abbreviation)

4 Symbols and abbreviations

ANSI	American National Standards Institute
BD	**Blu-ray Disc™ (that is a trademark of Blu-ray Disc™ Association)**
CEN TC 251	Comite Europeen de Normalisation – Technical Committee 251 – Medical Informatics

PS 3.11: Modify Annex D (Add BD profile – Uncompressed Profiles)

Annex D (Normative) - General Purpose CD-R ~~and~~, DVD, and BD Interchange Profiles

D.1 PROFILE IDENTIFICATION

This Annex defines an Application Profile Class potentially inclusive of all defined Media Storage SOP Classes. This class is intended to be used for the interchange of Composite SOP Instances via CD-R ~~and~~, DVD-RAM, **and BD** media for general purpose applications. Objects from multiple modalities may be included on the same media.

A detailed list of the Media Storage SOP Classes that may be supported is defined in PS 3.4.

Table D.1-1 STD-GEN Profile

Application Profile	Identifier	Description
General Purpose CD-R Interchange	STD-GEN-CD	Handles interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms.
General Purpose Interchange on DVD-RAM Media	STD-GEN-DVD-RAM	Handles interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms.
General Purpose Secure CD-R Interchange	STD-GEN-SEC-CD	Handles interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure Interchange on DVD-RAM Media	STD-GEN-SEC-DVD-RAM	Handles interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms. Offers confidentiality, integrity

		and, depending on the File-set creator's choice, data origin authentication.
General Purpose Interchange on BD Media	**STD-GEN-BD**	**Handles Interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms.**
General Purpose Secure Interchange on BD Media	**STD-GEN-SEC-BD**	**Handles Interchange of Composite SOP Instances such as Images, Structured Reports, Presentation States and Waveforms. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.**

The identifier for this General Purpose Image Exchange profile class shall be STD-GEN.

Equipment claiming conformance to this Application Profile shall list the subset of Media Storage SOP Classes that it supports in its Conformance Statement.

Note: Since it is not required to support all Media Storage Classes the user should carefully consider the subset of supported Media Storage SOP Classes in the Conformance Statements of such equipment to establish effective object interchange.

D.2 CLINICAL CONTEXT

This Application Profile facilitates the interchange of images and related data on CD-R **~~and~~,** DVD-RAM, **and BD media**. Typical interchange would be between acquisition devices, archives and workstations.

This Application Profile facilitates the creation of a multi-modality medium for image interchange, useful for clinical, patient record, teaching and research applications, within and between institutions.

This profile is intended only for general purpose applications. It is not intended as a replacement for specific Application Profiles that may be defined for a particular clinical context. The latter may support compression transfer syntaxes, limitations on the form and content of SOP Class instances, and specific media choices that preclude the use of the General Purpose Interchange Profile.

Note: The creation of a CD **~~or~~,** DVD-RAM**, or BD** is considerably more complex than the reading thereof. Therefore the clinical context for this Application profile is likely to be asymmetric, with a sophisticated File Set Creator and relatively simple File Set Readers.

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D.3.2 Physical Medium And Medium Format

The STD-GEN-CD and STD-GEN-SEC-CD application profiles require the 120 mm CD-R physical medium with the ISO/IEC 9660 Media Format, as defined in PS 3.12.

The STD-GEN-DVD-RAM and STD-GEN-SEC-DVD-RAM application profiles require the 120 mm DVD-RAM medium, as defined in PS 3.12.

The STD-GEN-BD and STD-GEN-SEC-BD application profiles require any of the 120 mm BD media, as defined in PS 3.12.

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D.3.5 Security Parameters

The STD-GEN-SEC-CD ~~**and,**~~ STD-GEN-SEC-DVD-RAM**, and STD-GEN-SEC-BD** application profiles require that all DICOM Files in the File-set including the DICOMDIR be Secure DICOM Files encapsulated in accordance with the requirements of the Basic DICOM Media Security Profile as defined in PS 3.15.

Note: These Application Profiles do not place any consistency restrictions on the use of the Basic DICOM Media Security Profile with different DICOM Files of one File-set. For example, readers should not assume that all Files in the File-set can be decoded by the same set of recipients. Readers should also not assume that all secure Files use the same approach (hash key or digital signature) to ensure Integrity or carry the same originators' signatures.

PS 3.11: Add new General Purpose BD Application Profiles with compression:

Annex X (Normative) - General Purpose BD with compression Interchange Profiles

X.1 PROFILE IDENTIFICATION

This Annex defines an Application Profile Class potentially inclusive of all defined Media Storage SOP Classes. This class is intended to be used for the interchange of Composite SOP Instances via BD media for general purpose applications. Objects from multiple modalities may be included on the same media. Images may be compressed with or without loss using either JPEG or JPEG 2000. And multi-frame images and video may be compressed with MPEG2 Main Profile / Main Level or MPEG2 Main Profile / High Level or MPEG-4 AVC/H.264 High Profile / Level 4.1 or MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1; all readers shall support compression.

A detailed list of the Media Storage SOP Classes that may be supported is defined in PS 3.4.

Table X.1-1 STD-GEN-BD and STD-GEN-SEC-BD Profiles

Application Profile	Identifier	Description
General Purpose BD Interchange with JPEG	STD-GEN-BD-JPEG	Handles interchange of Composite SOP Instances such as Images (optionally compressed with either lossless or lossy JPEG), Structured Reports, Presentation States and Waveforms.
General Purpose BD Interchange with JPEG 2000	STD-GEN-BD-J2K	Handles interchange of Composite SOP Instances such as Images (optionally compressed with either lossless or lossy JPEG 2000), Structured Reports, Presentation States and Waveforms.
General Purpose BD Interchange with MPEG2 MP@ML	STD-GEN-BD-MPEG2-MPML	Handles interchange of multi-frame images and video using MPEG2 MP@ML compression.
General Purpose BD Interchange with MPEG2 MP@HL	STD-GEN-BD-MPEG2-MPHL	Handles interchange of multi-frame images and video using MPEG2 MP@HL compression.

General Purpose BD Interchange with MPEG-4 AVC/H.264 HiP@Level4.1	STD-GEN-BD-MPEG4-HPLV41	Handles interchange of multi-frame images and video using MPEG-4 AVC/H.264 HiP@Level4.1 compression.
General Purpose BD Interchange with MPEG-4 AVC/H.264 BD-Compatible HiP@Level4.1	STD-GEN-BD-MPEG4-HPLV41BD	Handles interchange of multi-frame images and video using MPEG-4 AVC/H.264 BD-compatible HiP@Level4.1 compression.
General Purpose Secure BD Interchange with JPEG	STD-GEN-SEC-BD-JPEG	Handles interchange of Composite SOP Instances such as Images (optionally compressed with either lossless or lossy JPEG), Structured Reports, Presentation States and Waveforms. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure BD Interchange with JPEG 2000	STD-GEN-SEC-BD-J2K	Handles interchange of Composite SOP Instances such as Images (optionally compressed with either lossless or lossy JPEG 2000), Structured Reports, Presentation States and Waveforms. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure BD Interchange with MPEG2 MP@ML	STD-GEN-SEC-BD-MPEG2-MPML	Handles interchange of multi-frame images and video using MPEG2 MP@ML compression. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure BD Interchange with MPEG2 MP@HL	STD-GEN-SEC-BD-MPEG2-MPHL	Handles interchange of multi-frame images and video using MPEG2 MP@HL compression. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure BD Interchange with MPEG-4 AVC/H.264 HiP@Level4.1	STD-GEN-SEC-BD-MPEG4-HPLV41	Handles interchange of multi-frame images and video using MPEG-4 AVC/H.264 HiP@Level4.1 compression. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.
General Purpose Secure BD Interchange with MPEG-4 AVC/H.264 BD-compatible HiP@Level4.1	STD-GEN-SEC-BD-MPEG4-HPLV41BD	Handles interchange of multi-frame images and video using MPEG-4 AVC/H.264 BD-compatible HiP@Level4.1 compression. Offers confidentiality, integrity and, depending on the File-set creator's choice, data origin authentication.

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179 Equipment claiming conformance to this Application Profile shall list the subset of Media Storage SOP
180 Classes that it supports in its Conformance Statement.

Note: Since it is not required to support all Media Storage Classes the user should carefully consider the subset of supported Media Storage SOP Classes in the Conformance Statements of such equipment to establish effective object interchange.

X.2 CLINICAL CONTEXT

This Application Profile Class facilitates the interchange of images and related data on BD media. Typical interchange would be between acquisition devices, archives and workstations.

This Application Profile Class facilitates the creation of a multi-modality medium for image interchange, useful for clinical, patient record, teaching and research applications, within and between institutions.

This profile is intended only for general purpose applications. It is not intended as a replacement for specific Application Profiles that may be defined for a particular clinical context.

Notes: 1. The creation of a BD is considerably more complex than the reading thereof. Therefore the clinical context for this Application profile is likely to be asymmetric, with a sophisticated File Set Creator and relatively simple File Set Readers.

2. Each BD Rewritable/Recordable contains a unique ID, which can be read by a BD drive. This ID can be used for referring to a BD, for example in a database.

X.2.1 Roles and Service Class Options

This Application Profile Class uses the Media Storage Service Class defined in PS3.4 with the Interchange Option.

The Application Entity shall support one or more of the roles of File Set Creator (FSC) or File Set Reader (FSR), or File Set Updater (FSU) defined in PS 3.10.

X.2.1.1 File Set Creator

The role of File Set Creator shall be used by Application Entities that generate a File Set under this Interchange Class of Application Profiles.

File Set Creators shall be able to generate the Basic Directory SOP Class in the DICOMDIR file with all the subsidiary Directory Records related to the Image SOP Classes stored in the File Set. The Application Entity acting as a File Set Creator generates a File Set under a STD-GEN-BD or STD-GEN-SEC-BD Application Profile.

An FSC shall offer the ability to finalize the physical volume at the completion of the most recent write session (no additional information can be subsequently added to the volume), if supported by the media and file system specified in the profile.

Note: A multiple volume (i.e. a logical volume that can cross multiple physical media) is not supported by this class of Application profile. If a set of Files, e.g., a Study, cannot be written entirely on one physical volume (side of one piece of media), the FSC will create multiple independent DICOM File Sets such that each File Set can reside on a single physical volume (side of a single piece of media) controlled by its individual DICOMDIR file. The user of the FSC can opt to use written labels on the physical volumes to indicate that there is more than one physical volume for this set of files (e.g., a study).

X.2.1.2 File Set Reader

The role of File Set Reader shall be used by Application Entities which receive a transferred File Set under the Image Interchange Class of Application Profiles. Typical entities using this role would include

image generating systems, display workstations, and archive systems which receive a patient record; e.g. transferred from another institution.

File Set Readers shall be able to read the DICOMDIR directory file and all the SOP Instance files defined for this Application Profile, for which a Conformance Statement is made, using all the defined Transfer Syntaxes for the Profile.

Note: All Transfer Syntaxes defined in the profile must be supported by the FSR. It is not permissible to only support one or other of the uncompressed or the compressed Transfer Syntaxes.

X.2.1.3 File Set Updater

The role of File Set Updater is used by Application Entities that receive a transferred File Set under this Interchange Class of Application Profiles and update it by the addition (or deletion) of images or information to (or from) the medium. Typical entities using this role would include image generating systems and workstations that process or modify images.

File Set Updaters shall be able to generate one or more of the SOP Instances defined for this Application Profile, for which a Conformance Statement is made, and to read and update the DICOMDIR file.

An FSU shall offer the ability to finalize the physical volume at the completion of the most recent write session (no additional information can be subsequently added to the volume), if supported by the media and file system specified in the profile.

Note: If the volume has not been finalized, the File Set Updater will be able to update information assuming there is enough space on the volume to write a new DICOMDIR file, the information, and the fundamental volume control structures. Volume control structures are the structures that are inherent to the standards of the physical volume, see PS 3.12.

X.3 STD-GEN-BD AND STD-GEN-SEC-BD PROFILE CLASSES

X.3.1 SOP Classes and Transfer Syntaxes

This Application Profile is based on the Media Storage Service Class with the Interchange Option (see PS 3.4).

Table X.3-1
STD-GEN-BD and STD-GEN-SEC-BD SOP Classes and Transfer Syntaxes

Information Object Definition	Service Object Pair Class UID	Transfer Syntax and UID	FSC Requirement	FSR Requirement	FSU Requirement
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	Mandatory	Mandatory	Mandatory
Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	Explicit VR Little Endian Uncompressed 1.2.840.10008.1.2.1	Defined in Conformance Statement	Mandatory for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement

Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	JPEG Lossless Process 14 (selection value 1) 1.2.840.10008.1.2.4.70	Defined in Conformance Statement	Mandatory for JPEG profiles for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	JPEG Lossy, Baseline Sequential with Huffman Coding (Process 1) 1.2.840.10008.1.2.4.50	Defined in Conformance Statement	Mandatory for JPEG profiles for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only) 1.2.840.10008.1.2.4.51	Defined in Conformance Statement	Mandatory for JPEG profiles for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	JPEG 2000 Image Compression (Lossless Only) 1.2.840.10008.1.2.4.90	Defined in Conformance Statement	Mandatory for J2K profiles for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	JPEG 2000 Image Compression 1.2.840.10008.1.2.4.91	Defined in Conformance Statement	Mandatory for J2K profiles for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Multi-frame Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	MPEG2 Main Profile @ Main Level 1.2.840.10008.1.2.4.100	Defined in Conformance Statement	Mandatory for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement

Multi-frame Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	MPEG2 Main Profile @ High Level 1.2.840.10008.1.2.4.101	Defined in Conformance Statement	Mandatory for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Multi-frame Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	MPEG-4 AVC/H.264 High Profile / Level 4.1 1.2.840.10008.1.2.4.102	Defined in Conformance Statement	Mandatory for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement
Multi-frame Composite IODs for which a Media Storage SOP Class is defined in PS 3.4	*See PS 3.4*	MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1 1.2.840.10008.1.2.4.103	Defined in Conformance Statement	Mandatory for all SOP Classes defined in Conformance Statement	Defined in Conformance Statement

The SOP Classes and corresponding Transfer Syntax supported by this Application Profile are specified in the Table X.3-1. The supported Storage SOP Class(es) shall be listed in the Conformance Statement using a table of the same form.

X.3.2 Physical Medium And Medium Format

The STD-GEN-BD and STD-GEN-SEC-BD application profiles require any of the 120 mm BD media, as defined in PS 3.12.

X.3.3 Directory Information in DICOMDIR

Conformant Application Entities shall include in the DICOMDIR File the Basic Directory IOD containing Directory Records at the Patient and the subsidiary Study and Series levels, appropriate to the SOP Classes in the File Set.

All DICOM files in the File Set incorporating SOP Instances defined for the specific Application Profile shall be referenced by Directory Records.

Note: DICOMDIRs with no directory information are not allowed by this Application Profile.

All implementations shall include the DICOM Media Storage Directory in the DICOMDIR file. There shall only be one DICOMDIR file per File Set. The DICOMDIR file shall be in the root directory of the medium. The Patient ID at the patient level shall be unique for each patient directory record in one File Set.

X.3.3.1 Additional Keys

File Set Creators and Updaters are required to generate the mandatory elements specified in PS 3.3.

Table H.3-2 in Annex H STD-GEN-DVD and STD-GEN-SEC-DVD Additional DICOMDIR Keys specifies the additional associated keys that shall also be applicable to the profiles defined in this Annex. At each

directory record level other additional data elements can be added, but it is not required that File Set Readers be able to use them as keys. Refer to the Basic Directory IOD in PS 3.3.

X.3.4 Other Parameters

X.3.4.1 Multiframe JPEG Format

The JPEG encoding of pixel data shall use Interchange Format (with table specification) for all frames.

X.3.5 Security Parameters

The STD-GEN-SEC-BD application profiles require that all DICOM Files in the File-set including the DICOMDIR be Secure DICOM Files encapsulated in accordance with the requirements of the Basic DICOM Media Security Profile as defined in PS 3.15.

Note: These Application Profiles do not place any consistency restrictions on the use of the Basic DICOM Media Security Profile with different DICOM Files of one File-set. For example, readers should not assume that all Files in the File-set can be decoded by the same set of recipients. Readers should also not assume that all secure Files use the same approach (hash key or digital signature) to ensure integrity or carry the same originators' signatures.

Changes to NEMA Standards Publication PS 3.12-2009

Digital Imaging and Communications in Medicine (DICOM)

Part 12: Media Formats and Physical Media for Data Interchange

PS 3.12: Modify section 2 (Add references)

2 Normative references

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DVD+ Alliance. DVD+RW Defect Management & Physical Formatting Specification, Version 1.0, December 2001.

DVD+ Alliance. DVD+R Physical Specifications, Version 1.1, August 2002.

Note: These references will be replaced by the corresponding ISO or ECMA reference when available.

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Format 1.A Physical Format Specifications for BD-RE (2nd Edition, February 2006).

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Recordable Format Part 1 Physical Specifications (February 2006).

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ 1.C Physical Format Specifications for BD-ROM 5th Edition (March, 2007).

OSTA Universal Disk Format Specification (UDF) Version 2.5. April 30, 2003.

OSTA Universal Disk Format Specification (UDF) Version 2.6. March 1, 2005.

RFC 3240, Digital Imaging and Communications in Medicine (DICOM) - Application/dicom MIME Sub-type Registration

ISO/IEC IS 15286:1999 Data Interchange on 130mm Optical Disk Cartridges - Capacity 5.2GB Per Cartridge.

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PS 3.12: Modify section 4 (Add abbreviations)

4 Symbols and abbreviations

The following symbols and abbreviations are used in this part of the standard.

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ASTM	American Society for Testing and Materials
BD	**Blu-ray Disc™**
BD-RE	**Blu-ray Disc™ Rewritable**
BD-R	**Blu-ray Disc™ Recordable**
CD	Compact Disk

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PS 3.12: Add new Annex specifying the 120 mm BD Medium:

Annex X 120 mm BD Medium (Normative)

This Annex defines the use of the UDF file systems with BD media in such a manner as to require a reader to be capable of reading all of the physical media types and UDF file system versions that are defined in this Annex, and a creator to be able to create at least one of those types of media and file system.

The media types supported are BD-RE and BD-R.

Note: Capitalization in this annex may be inconsistent with other DICOM standards in order to be consistent with historical usage for terms in referenced documents.

Universal Disk Format (UDF) is a profile of the ECMA 167 3rd edition file system.

Note: The ECMA 167 3rd edition is more recent than ISO 13346:1995 which is equivalent to ECMA 167 2nd edition.

X.1 DICOM MAPPING TO MEDIA FORMAT

X.1.1 Media Character Set

The character set used in UDF fields shall be the CS0 OSTA Compressed Unicode character set, required by the UDF standard.

Notes: 1. The CS0 OSTA Unicode character set is defined in UDF and is a subset of Unicode 2.0.

2. UDF defines a specific form of compression of 8 and 16 bit Unicode characters that must be supported.

3. The character set defined elsewhere in this section for DICOM File-set fields is a subset of this character set. However other fields in the UDF file system, and other files in the UDF file system not in the DICOM File-set, may use characters beyond those defined by DICOM for File ID Components, including those encoded in 16 bits.

X.1.2 DICOM File-set

One and only one DICOM File-set shall be stored on each side of a single piece of media.

A DICOM File-set is defined to be completely contained within one UDF File-set.

Only a single UDF File-set shall be present in the UDF Volume.

Each side of the media will comprise a single self-contained UDF Volume. That is the UDF Volume Set shall not consist of more than one UDF Volume.

Only a single UDF Partition shall be present on each side of the media.

Note: Both sides of a single piece of media may be used for storing DICOM data, when separate DICOM File-sets are created.

X.1.3 DICOM File ID Mapping

The UDF Standard provides a hierarchical structure for directories and files within directories. Each volume has a root directory that may contain references to both files and subdirectories. Subdirectories may contain reference to both files and other subdirectories.

X.1.3.1 File ID

PS 3.10 defines a DICOM File ID Component as a string of 8 characters from a subset of the G0 repertoire of ISO 8859. Each of these File ID Components is mapped to a UDF File Identifier or Path Component in the OSTA CS0 character set.

Note: This mapping is a subset of the MS-DOS mapping specified in UDF.

Filename extensions are not used in DICOM File ID Components, hence a UDF File Identifier shall not contain a File Extension or the '.' that would precede such a File Extension.

The maximum number of levels of a Resolved Pathname in a UDF file-set shall be at most 8 levels, to comply with the definition of a DICOM File-set in PS 3.10.

The File Version Number is always equal to 1, as specified by UDF.

X.1.3.2 DICOMDIR File

A DICOMDIR file in a DICOM File-set shall reside in the root directory of the directory hierarchy, as specified in PS 3.10.

X.1.4 DICOM File Management Information

No file management information beyond that specified in the UDF File Entry is required. In particular no Extended Attributes or Named Streams are required.

X.2 FILESYSTEM

X.2.1 UDF File system

The reader shall be able to read a logical format conforming to UDF 2.5 on BD-RE media and shall be able to read a logical format conforming to UDF 2.6 on BD-R media.

The creator shall be able to create a logical format conforming to UDF 2.5 on BD-RE media and shall be able to create a logical format conforming to UDF 2.6 on BD-R media.

The updater shall be able to update a logical format conforming to UDF 2.5 on BD-RE media and shall be able to update a logical format conforming to UDF 2.6 on BD-R media, without updating the UDF revision level of the file system already recorded on the media.

Options or extensions defined in UDF are required or restricted as specified in the following sub-sections, and in the media specific sub-sections.

Notes: 1. Though the names of the files within the DICOM File-set are restricted by PS 3.10, other files on the media may have longer filenames up to 255 characters, which is the maximum for UDF 2.5 and UDF 2.6.

2. A Pseudo Overwrite Method is defined in the BD-R standard. It is used to make Write-Once media behave like rewritable media, hence sector format compatibility is ensured without multi-session or packet-written format. BD drives support Pseudo Overwrite management for BD-R. For Pseudo Overwrite Method the UDF version must be 2.6.

X.2.1.1 Interchange Levels

For the UDF Primary Volume Descriptor, both the Interchange Level and Maximum Interchange Level shall always be set to 2.

Notes: 1. This means that the volume is not and will never be, part of a multi-volume set.

2. The Interchange Level and Maximum Interchange Level in the File Set Descriptor are defined by UDF to always be 3. This is despite the fact that restrictions specified for the DICOM File-set may be very similar to lower Interchange Levels specified in ECMA 167.

X.2.1.2 Virtual Partition Maps and Allocation Tables

Creators and updaters shall not write UDF Virtual Partition Maps and Virtual Allocation Tables on BD-RE and BD-R media, since pseudo overwrite management is performed in the drive.

X.2.1.3 Sparable Partition Maps and Sparing Tables

Creators and updaters shall not write UDF Sparable Partition Maps and Sparing Tables on BD-RE and BD-R media, since defect management is performed in the drive.

X.2.1.4 System Dependent Requirements

The reader shall not depend on any system dependent requirements as specified in UDF to be able to read the DICOM File-set, and shall not behave differently if they are present. Any unrecognized system dependent requirements shall be gracefully ignored.

Creators and updaters writing to a version of UDF that supports Named Streams shall use the default stream to write each file within the DICOM File-set.

Notes: 1. For example, a particular form of file permissions, particular extended attributes or particular named streams may not be required or affect application behavior.

2. This does not mean that Extended Attributes or Named Streams may not be present and associated with files within the DICOM File-set.

X.2.1.5 Permissions and File Characteristics

Creators and updaters shall always create permissions for files within the DICOM File Set such that all users may create, read, write and delete all files, and all users may access, create, modify and delete all directories on all systems.

Notes: 1. These requirements are equivalent to setting a Unix permission of 644 for files and 755 for directories.

2. The intent of these requirements is that for DICOM interchange media, implementation specific access control is not used or required.

The UDF File Identifier Descriptor for files within the DICOM File Set shall not specify a File Characteristic of "hidden."

X.2.1.6 File Types

The UDF File Types within the DICOM File Set shall only be files (that is a File Type of 0, meaning unspecified interpretation) or symbolic links to files (that is a File Type of 12).

X.3 MEDIA FORMATS

X.3.1 Blu-ray Disc™

X.3.1.1 BD Physical Format

The physical format of BD media shall comply with one of the following applicable definitions:

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Format 1.A Physical Format Specifications for BD-RE (2nd Edition, February 2006).

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Recordable Format Part 1 Physical Specifications (February 2006).

X.3.1.1.1 BD Sector Format

The sector format of BD media shall comply with one of the following applicable definitions:

OSTA Universal Disk Format Specification (UDF) Version 2.5. April 30, 2003.

OSTA Universal Disk Format Specification (UDF) Version 2.6. March 1, 2005.

Note: BD-RE is a truly random access medium, providing random access to fixed length sectors, hence no multi-session is applicable and packet-written format is not necessary.

X.3.1.2 BD Logical Format

There are no requirements, restrictions, options or extensions to the logical format that are specific to this media type, beyond those specified in section X.2.

X.3.1.3 BD Physical Media

The physical medium shall be the 120 mm BD medium as defined in one of the following:

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Format 1.A Physical Format Specifications for BD-RE (2nd Edition, February 2006).

Blu-ray Disc™ Association. White Paper Blu-ray Disc™ Recordable Format Part 1 Physical Specifications (February 2006).