

Sup-C DCMviewer

DICOM Conformance Statement

Product	Sup-C DCMviewer, executable `sup-c_dcmviewer`
Version	2.0.0
Document	DICOM Conformance Statement 2.1
Date	2026-11-11
Manufacturer	Sup-C — www.sup-c.com
Copyright	Copyright © 2026 Patrick Cleys / Sup-C
Licence	Freeware — free for personal and commercial use; redistribution only in unmodified form (LICENSE.txt)

For image review only — not a certified diagnostic workstation. This product is not a medical device.

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DICOM Conformance Statement

Product	Sup-C DCMviewer (executable `sup-c_dcmviewer`, Windows x64/x86, macOS universal, Linux x86-64)
Manufacturer	Sup-C (Patrick Cleys), www.sup-c.com
Copyright	Copyright © 2026 Patrick Cleys / Sup-C. All rights reserved.
Licence	Freeware — free for personal and professional use, free redistribution of the unmodified software, including commercially. See `LICENSE.txt` and §17.
Product version	2.0.0
Document version	2.0 (draft for review)
Document date	2026-11-11
Format	Follows the structure of DICOM PS3.2 (Conformance), adapted to a stand-alone media viewer
Intended use of the product	Image review of DICOM media (CD, DVD, USB) produced by Sup-C DCMburner. **Not a certified diagnostic workstation and not a medical device.**

How to read the status marks in this document

Mark	Meaning
✅ **Verified**	Implemented and checked against an independent reference decoder or by automated tests (see §13 and `VALIDATION.md`).
🔶 **Implemented, not verified**	Implemented in the code; no test file or reference comparison was available.
❌ **Not supported**	Not implemented. The viewer shows a clear message or ignores the object, as described.

1. Introduction

1.1 Revision history

Document version	Date	Description
1.0	2026-11-06	First version, written for product version 1.0.0.
2.0	2026-11-11	Product version 2.0.0: hanging protocols, MPR, 3D, measurements, dose icon, KOS, GSPS (see §16).
2.1	2026-11-11	Freeware licence, ownership and branding (see §17); `LICENSE.txt`; About window. Technical content unchanged.

1.2 Audience, remarks and scope

This document specifies how Sup-C DCMviewer ("the viewer") interprets DICOM data that it reads. It is intended for hospitals, integrators and other implementers who need to know whether DICOM media can be reviewed with the viewer.

The viewer is a **Media Storage reader**. It is **not** a network DICOM node: it has no Application Entity, opens no sockets and performs no DICOM network services (§3). It **never writes or modifies DICOM files** and does not create DICOM objects.

This Conformance Statement describes the viewer; it is not a guarantee of interoperability. As with any viewer, DICOM media from a given modality or PACS should be test-viewed before the viewer is relied on for a batch of discs. Vendor-specific behaviours that were not available as test data are marked "implemented, not verified".

1.3 Definitions and terms

Term	Meaning
FSR	File Set Reader, the role of a Media Storage application that reads a DICOM File-set (PS3.10, PS3.11)
Part 10 file	DICOM file with 128-byte preamble, `DICM` prefix and File Meta Information
Viewport	One image cell in the viewer's grid (1×1 up to 4×4)
Series, Study	As in PS3.3 (Patient / Study / Series / Image hierarchy)
Document object	An object that is not shown as pixels in a viewport: Encapsulated PDF, MPEG video, Structured Report, waveform

1.4 Abbreviations

AE Application Entity · CAD Computer-Aided Detection · CT Computed Tomography · DICOMDIR Media Storage Directory · DLP Dose-Length Product · DAP Dose-Area Product · ECG Electrocardiogram · LUT Look-Up Table · MR Magnetic Resonance · PDF Portable Document Format · RDSR Radiation Dose Structured Report · SOP Service-Object Pair · SR Structured Report · UID Unique Identifier · VOI Value Of Interest · VR Value Representation.

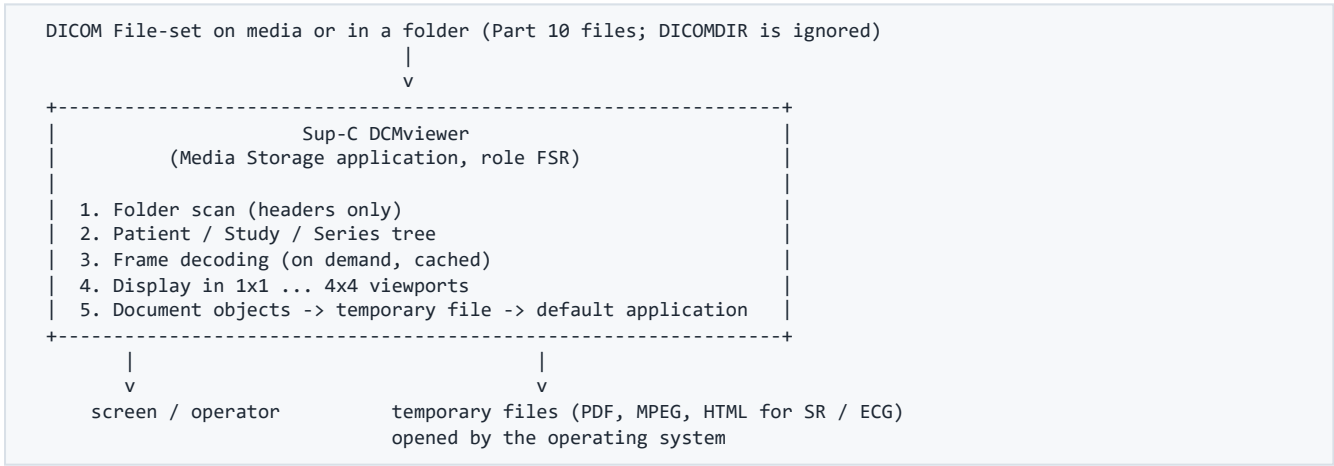
1.5 References

- DICOM PS3.2 Conformance · PS3.3 Information Object Definitions · PS3.4 Service Class Specifications · PS3.5 Data Structures and Encoding · PS3.6 Data Dictionary · PS3.10 Media Storage and File Format · PS3.11 Media Storage Application Profiles · PS3.12 Media Formats and Physical Media · PS3.16 Content Mapping Resource (current edition at time of writing).
- `README.md`, `VALIDATION.md`, `BUILD.md`, `LICENSES-THIRD-PARTY.md` of the product.

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2. Implementation model

2.1 Application data flow



There is exactly one local Real-World Activity: **"Review DICOM media"**. No data leaves the program except the temporary files of document objects (§11).

2.2 Functional definition of Application Entities

The viewer contains **no DICOM Application Entity** (no AE Title, no association handling, no Service Class User or Provider). Its media role is described in §4.

2.3 Sequencing of real-world activities

1. The operator starts the program. If a folder is given on the command line, or a `DICOM` folder / `DICOMDIR` file is found next to (or up to three levels above) the executable, scanning starts automatically; otherwise the operator uses *Open folder…* (§12).
2. The scan runs in the background; results appear in the tree while scanning. A progress indicator is shown.

3. When the first batch has arrived, and again when the scan has finished (unless the operator has chosen something in the meantime), the **first series with images of the first study of the first patient** is shown (§8.5).
4. The operator selects series or studies, scrolls, adjusts window/level, zoom and pan, changes the layout, opens document objects, and views the Tags window.

2.4 File Meta Information

The viewer reads the File Meta Information of every Part 10 file (Media Storage SOP Class UID, Transfer Syntax UID are used). It **writes no File Meta Information** and therefore has no Implementation Class UID or Implementation Version Name of its own.

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3. Network communication support

Item	Status
DICOM network services (Storage, Query/Retrieve, Print, Verification, Worklist, ...)	❌ **None.** The viewer is not a network application.
Application Entity title, port, association negotiation	Not applicable.
Any other network traffic (telemetry, update check, licence check, cloud access)	**None.** The program opens no network connections.

The viewer is therefore not subject to network security profiles (TLS, user identity, etc.).

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4. Media interchange support

4.1 AE specification: "Sup-C DCMviewer" (File Set Reader)

Application Entity	Role	Supported
Sup-C DCMviewer	FSR (File Set Reader)	Yes: reads DICOM files from a folder, a mounted CD/DVD/USB volume or a network share
	FSC (File Set Creator)	❌ No
	FSU (File Set Updater)	❌ No

4.2 Real-World Activity: Review DICOM media

Scanning rules (✅ verified by integration test on a 304-file medium; `README.md`):

- The selected folder is scanned **recursively**, to a depth of 32 levels, in a deterministic order. Symbolic links are not followed. Folders of viewer bundles (`*.app`) and operating-system metadata (`__MACOSX`, `.Trashes`, `.Spotlight-V100`, `.fseventsd`, `System Volume Information`, `$RECYCLE.BIN`) are skipped.
- A file is considered DICOM only if it is a **Part 10 file** (128-byte preamble followed by `DICM`). Files without a preamble are ignored silently. File names and extensions are irrelevant; any name (for example `IM0`, `00000001`, `*.dcm`) is accepted.
- Only the header is parsed during scanning (reading stops at Pixel Data), so scanning a disc does not read image data.
- Malformed files, or files that cannot be parsed, are listed under **Problems** with the reason; they do not stop the scan. Identical SOP Instance UIDs that occur more than once (for example a copied folder) are shown once.
- **DICOMDIR is not read.** A file named `DICOMDIR` (any case) is skipped, and all other files are discovered by the folder scan. As a consequence, patient/study/series information comes from the DICOM files themselves, never from the directory records. Files that are referenced by a DICOMDIR but are not stored in the scanned tree are not found, and files that exist in the tree but are not referenced by a DICOMDIR **are** shown.

4.3 Media Storage Application Profiles

No Media Storage Application Profile is claimed. The viewer is a generic reader of Part 10 files and can therefore read the files of any application profile (for example the General Purpose CD-R / DVD / USB profiles of PS3.11) provided that they conform to the points in this statement. It does not check the media format, file naming rules (8.3 names, ISO 9660 level) or the profile-specific SOP Class / Transfer Syntax restrictions.

4.4 Augmented and private application profiles

None.

4.5 Media-specific considerations

- The program is **read-only**: it never opens files for writing in the scanned tree. Reading from write-protected, optical and read-only media is supported.
- The program discovers its media automatically as described in §12.2 when it runs from the disc (for example `<disc>\Windows\sup-c_dcmviewer.exe` next to a `DICOM` folder).
- The program does not require installation, administrator rights or additional runtime libraries on Windows (static C runtime; it imports only Windows system DLLs).

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5. Supported information objects (SOP Classes)

The viewer does **not filter by SOP Class UID** when deciding whether an object is an image. It chooses how to handle an object from its content:

1. Encapsulated PDF, Structured Report, waveform SOP Classes and video transfer syntaxes are recognised by SOP Class UID / Transfer Syntax UID (§9).
2. Every other object with Rows, Columns, Bits Allocated and Pixel Data is treated as an **image** and decoded according to the Image Pixel Module (§7).
3. Objects that match none of these are listed in the tree as "objects" and are not displayed.

5.1 Image objects

Class of objects	SOP Class UIDs (examples; full list in Annex B)	Status
CT, Enhanced CT, MR, Enhanced MR	1.2.840.10008.5.1.4.1.1.2, .2.1, .4, .4.1	✅ CT/MR verified with real media (single- and multi-frame, various transfer syntaxes)
CR, DX (presentation / processing), digital mammography, intra-oral radiography	…1.1, 1.1.1, 1.1.1.1, 1.1.2, 1.1.2.1, 1.1.3, 1.1.3.1	✅ DX and mammography checked on real media; CR 🔶
Breast Tomosynthesis	1.2.840.10008.5.1.4.1.1.13.1.3	✅ opened on real media (multi-frame, hundreds of MB); decoding verified, tomosynthesis-specific geometry not interpreted
Ultrasound, Ultrasound Multi-frame	…6.1, 3.1 (and retired 6, 3)	✅ (including PALETTE COLOR ultrasound)
Secondary Capture (single and multi-frame, grayscale, true colour)	…7, 7.1, 7.2, 7.3, 7.4	✅
XA, Enhanced XA, XRF, Enhanced XRF	…12.1, 12.1.1, 12.2, 12.2.1	🔶
Nuclear Medicine, PET, Enhanced PET	…20, 128, 130	🔶
Visible Light (endoscopic, microscopic, slide-coordinates, photographic, video photographic) images	…77.1.1 – 77.1.4	🔶 still images; for video transfer syntaxes see §9.3
Any other SOP Class whose pixel data is described by the Image Pixel Module		🔶 decoded according to §7; the SOP Class specific semantics are **not** interpreted

5.2 Objects displayed outside the viewport (see §9)

Object	SOP Class UIDs	Status
Encapsulated PDF	1.2.840.10008.5.1.4.1.1.104.1	✅ extracted and opened with the default PDF application
Structured Reports (all SR classes)	1.2.840.10008.5.1.4.1.1.88.* — e.g. Basic Text .88.11, Enhanced .88.22, Comprehensive .88.33, Comprehensive 3D .88.34, Mammography CAD .88.50, Key Object Selection .88.59, X-Ray Radiation Dose .88.67, Radiopharmaceutical Radiation Dose .88.68	✅ Basic Text, Mammography CAD, X-Ray Radiation Dose (synthetic); 🔶 other classes via the same generic renderer
ECG waveforms	12-lead …9.1.1, General …9.1.2, Ambulatory …9.1.3	✅ 12-lead verified against pydicom
Other waveforms	Hemodynamic …9.2.1, Basic Cardiac EP …9.3.1, Arterial Pulse …9.5.x, Respiratory …9.6.x, EEG/EMG/EOG/Sleep …9.7.x	🔶 same parser and renderer as ECG
Video	any image SOP Class stored with Transfer Syntax …4.100 – …4.108 (MPEG-2, MPEG-4 AVC/H.264, HEVC)	✅ MPEG-2 (Video Endoscopic Image) verified; 🔶 H.264/HEVC

5.3 Objects that are not displayed

Listed in the tree with a count of "objects"; Key Object Selection and GSPS (graphics only) are used to mark key images and draw annotations. Not shown: other Presentation States (colour, pseudo-colour, blending), Hanging Protocols, Key/Overlay/Curve objects stored stand-alone, RT objects (RT Image is shown as an image; RT Structure Set, Plan, Dose, Beams treatment records are not interpreted), Segmentation, Registration, Fiducials, Surface, Parametric Map (float pixel data), Raw Data, Spectroscopy, Encapsulated CDA / STL / MTL / OBJ, Real World Value Mapping, Audio waveforms, Ophthalmic measurements, Implant templates, and any private SOP Class.

> Objects whose pixel data is integer-valued and valid (for example Segmentation as 1-bit frames, RT Dose as 16/32-bit) may be shown as a plain image because of rule 2 above. They are shown as **raw pixel values** with no segmentation colours, dose scaling or overlay on the referenced image.

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6. Supported transfer syntaxes

Transfer Syntax	UID	Status	Notes
Implicit VR Little Endian	1.2.840.10008.1.2	✅	
Explicit VR Little Endian	1.2.840.10008.1.2.1	✅	
Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	✅	
Explicit VR Big Endian (retired)	1.2.840.10008.1.2.2	✅	including 32-bit samples
JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50	✅	8-bit, matches libjpeg-turbo within ±1 (lossy)
JPEG Extended (Processes 2 & 4)	1.2.840.10008.1.2.4.51	✅ 8-bit / ❌ 12-bit	12-bit gives a clear error
JPEG Lossless, SV1 (Process 14)	1.2.840.10008.1.2.4.70	✅	exact
JPEG Lossless, Process 14 (other selection values)	1.2.840.10008.1.2.4.57	🔶	same decoder; not tested with a real file
JPEG-LS Lossless	1.2.840.10008.1.2.4.80	✅	pure-Rust decoder; 8–16 bit, grayscale and colour, all interleave modes; exact against CharLS
JPEG-LS Near-Lossless	1.2.840.10008.1.2.4.81	✅	as above; identical to CharLS output
JPEG 2000 Lossless Only	1.2.840.10008.1.2.4.90	✅	exact (OpenJPEG-compatible decoder in Rust)

Transfer Syntax	UID	Status	Notes
JPEG 2000	1.2.840.10008.1.2.4.91	✅	lossy; compared with OpenJPEG
JPEG 2000 Part 2 (Multi-component)	1.2.840.10008.1.2.4.92 / .93	🔶	
RLE Lossless	1.2.840.10008.1.2.5	✅	8/16-bit; ❌ 32-bit samples
MPEG-2 MP@ML / MP@HL, MPEG-4 AVC/H.264 (all profiles), HEVC/H.265	1.2.840.10008.1.2.4.100 – .108	video	not decoded: the stream is extracted and opened in the system's video player (§9.3)
High-Throughput JPEG 2000 (all variants)	1.2.840.10008.1.2.4.201 – .203	❌	
JPEG XL	1.2.840.10008.1.2.4.110 – .112	❌	
JPEG Extended hierarchical, lossless hierarchical, arithmetic-coded and other retired JPEG processes	...4.52 – .56, .58 – .69, .71 – .79	❌	
SMPTE ST 2110, Deflated Image Frame Compression, RFC 2557 MIME, Encapsulated Uncompressed	various	❌	

Frame handling. Each frame of a multi-frame object is decoded on demand; a single bad frame or file does not affect others. A decoder that fails (corrupt data) is caught and reported as an error for that image only.

Lossy compression. For lossy transfer syntaxes (JPEG Baseline/Extended, JPEG 2000 lossy, JPEG-LS near-lossless) and for objects with Lossy Image Compression (0028,2110) = `01`, the viewport shows the warning **"LOSSY COMPRESSED"**.

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7. Image display behaviour

7.1 Image Pixel Module

Attribute	Handling	Status
Samples per Pixel (0028,0002)	1 or 3	✅
Photometric Interpretation (0028,0004)	MONOCHROME1, MONOCHROME2, RGB, YBR_FULL, YBR_FULL_422, YBR_ICT, YBR_RCT (the last two as produced by JPEG 2000 decoders), PALETTE COLOR	✅
	YBR_PARTIAL_420, YBR_PARTIAL_422, HSV, ARGB, CMYK	❌ error message
Planar Configuration (0028,0006)	0 and 1 (uncompressed colour)	✅
Rows, Columns (0028,0010/0011)	up to 120,000,000 pixels per frame (64-bit build); 40,000,000 (32-bit build); larger frames give an error	✅
Bits Allocated (0028,0100)	1, 8, 16, 32	✅
Bits Stored / High Bit (0028,0101/0102)	honoured: values are masked and, for signed data, sign-extended; inconsistent combinations give an error	✅
Pixel Representation (0028,0103)	0 (unsigned) and 1 (two's complement)	✅
Pixel Data (7FE0,0010)	native or encapsulated	✅
Float Pixel Data, Double Float Pixel Data	❌	"parametric maps" are listed but not displayed
Number of Frames (0028,0008)	all frames are shown as separate images	✅
Pixel Padding Value / Range, Smallest/Largest Image Pixel Value	not applied; not used	❌

Attribute	Handling	Status
Palette Color Lookup Table Descriptor / Data / Segmented Data (0028,1101–1103, 1201–1203, 1221–1223)	applied, see §7.4	✅
Overlay Plane (60xx,xxxx), Curve Data	not displayed	❌
ICC Profile, Color Space	not interpreted; colour is shown as stored (treated as sRGB)	❌

7.2 Modality LUT (rescaling)

- **Rescale Slope (0028,1053) and Rescale Intercept (0028,1052)** are applied to monochrome images (CT Hounsfield units, etc.), including per-frame values from the Pixel Value Transformation Sequence of enhanced multi-frame objects (Per-Frame / Shared Functional Groups). ✅
- A slope of 0 is treated as 1. Rescale Type is not used for display.
- **Modality LUT Sequence (0028,3000) is not applied.** The viewport shows the warning "Modality LUT Sequence present but not applied". ❌
- The Modality LUT is not applied to PALETTE COLOR indices.

7.3 VOI LUT (window/level) and Presentation LUT

- The initial window is taken from the **first** Window Center / Window Width (0028,1050/1051) value of the object, or from the Frame VOI LUT Sequence (per frame, then shared) for enhanced multi-frame objects. Window Width ≤ 0 is ignored. ✅
- **VOI LUT Function (0028,1056)**: LINEAR, LINEAR_EXACT and SIGMOID, as in PS3.3 C.11.2.1.2. ✅
- When no window is given, the **full pixel value range** of the frame is used. A "Default (from file)" and "Full range" choice exist, as well as **CT presets** (brain 40/80, soft tissue 40/400, lung −600/1500, bone 400/1800) for images in Hounsfield units. The operator can change window/level with the mouse; the change is applied to every viewport that shows the same series.
- **Further windows in the same object** (Window Center & Width Explanation) are not offered; only the first is used. 🔶
- **VOI LUT Sequence (0028,3010) is not applied.** The viewport shows the warning "VOI LUT Sequence present but not applied". ❌
- **Presentation LUT Shape (2050,0020)** is not read. MONOCHROME1 images are displayed with inverted grayscale (low values bright), and the operator may invert any image manually. ✅ for MONOCHROME1; ❌ for IDENTITY/INVERSE shape handling.
- **Presentation States**: only the graphic annotations of a Grayscale Softcopy Presentation State are drawn (§16); shutters, LUTs, spatial transformations, colour and blending are not applied. 🔶

7.4 PALETTE COLOR

Pixel values are used as indices into the Red/Green/Blue Palette Color Lookup Tables (✅ verified against `pydicom.pixels.apply_color_lut`, 11 frames, 0 differences):

- Descriptor with 8- or 16-bit entries, entry count (0 = 65,536), and *first mapped value* (also negative for signed indices); 16-bit entries are reduced to their high byte for display; 8-bit entries may be packed or one per word.
- **Segmented palettes**: discrete and linear segments. **Indirect segments are not supported** (clear error).
- Values before the first mapped entry use the first colour; values after the last use the last colour (PS3.3 C.7.6.3.1.5).
- The three tables must have the same size and first mapped value; otherwise an error is shown.

7.5 Colour images

RGB and YBR images are converted to 8-bit RGB for display (16-bit samples are reduced by `Bits Stored − 8` bits). YBR_FULL / YBR_FULL_422 data are converted with the JFIF equations; a JPEG stream without a colour-space marker is interpreted according to Photometric Interpretation (a warning is shown). ✅

7.6 Display precision and calibration

Monochrome images are held as 32-bit floating-point modality values and mapped to **8 bits per pixel** for the screen. The viewer does **not** apply a display calibration (no DICOM Grayscale Standard Display Function, no display-specific LUT) and no quality-control checks. **It is not suitable for primary diagnosis.** The non-diagnostic notice is shown permanently in the status bar and in the window title.

7.7 Geometry and annotation

Item	Handling
Pixel Spacing (0028,0030), Pixel Measures Sequence (per frame/shared), Imager Pixel Spacing (0018,1164)	used for the **display aspect ratio only**; images are never stretched when the spacing is square. Rows and columns with different spacing are shown with correct proportions. Spacing is also printed in the Tags window.
Pixel Aspect Ratio (0028,0034)	not used
Image Position / Orientation (Patient)	used for **slice ordering** (§8.3), the hanging protocols and MPR / 3D (§16); no reference lines, localizer or cross-referencing
Rotation, flip	❌ not available
Measurements	✅ distance, angle, rectangular / elliptical ROI (§16); annotations and graphic layers ❌

7.8 Overlay text in the viewport

The overlay shows (depending on the viewport size, never overlapping): patient name; series description; study date; modality; image number *n / N*; window width / window level; zoom percentage; the warning "LOSSY"; and, for large viewports, the pixel position and value under the cursor (in modality units, e.g. HU, or RGB). The operator can switch all overlays off. Every other attribute can be inspected in the **Tags** window, which lists all data elements of the current file, including nested sequences (to a depth of 6) and private elements, with tag, VR, name and value.

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8. Patient, study, series and instance handling

8.1 Identification and grouping

Level	Key used for grouping
Patient	Patient ID (0010,0020) **and** Patient's Name (0010,0010) together; two objects with the same ID but different names appear as two patients
Study	Study Instance UID (0020,000D); if missing, a key derived from the folder name
Series	Series Instance UID (0020,000E); if missing, a key derived from the folder name
Instance	SOP Instance UID (0008,0018); duplicates are shown once

The tree is sorted by patient name (then Patient ID), **studies newest first** (Study Date and Time, descending) and series by Series Number. Names are displayed with the DICOM name components separated into "Family, Given". Dates and times are shown in ISO format.

8.2 Series and instance descriptions

The tree row of a series shows its modality badge (for non-image series: PDF, MPEG, SR, ECG or WAVE), the series number, the description and the number of images (or objects).

8.3 Image order within a series ✅

1. **Geometric order**: if every image of the series is single-frame, has Image Position (Patient) and the same Image Orientation (Patient) (tolerance 0.001), the images are sorted along the slice normal. The direction follows the direction of the Instance Numbers (head-to-feet acquisitions keep their sequence).
2. **Otherwise** by Instance Number (0020,0013), then by file path.
3. Multi-frame objects are expanded: every frame is one image, in frame order.

The sort method used is shown in the Tags window and not on the image.

8.4 Viewports and studies

- The viewer shows up to **16 viewports** in a grid (1×1 … 4×4). **All viewports always belong to one study**: selecting a series or study from another study replaces the whole grid. A series from another study cannot be dropped into a single viewport.
- The viewer chooses the layout from the content: 1 image → 1×1, 2 → 1×2, 3 → 1×3, 4 → 2×2, 5–6 → 2×3, 7–8 → 2×4, 9 → 3×3, 10–12 → 3×4, 13 or more → 4×4. A study whose images are almost all in one series is tiled from that series; otherwise each series of the study gets its own viewport.
- A tiled series shows consecutive images in consecutive viewports; scrolling moves all of them. Window/level, zoom, pan and inversion apply to **every viewport that shows the same series**.
- Viewports show only the pixel data of the current frame; no spatial synchronisation between different series is performed.

8.5 Startup behaviour

The first series with images of the **first study of the first patient** in tree order (that is: the first patient by name, and that patient's newest study) is shown, spread over the best layout for its number of images (§8.4). If that study has no image series, its first document object is offered.

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9. Non-image objects: documents, reports, ECG, video

The viewer has **no embedded PDF viewer, video player, browser or report renderer**. A document object is extracted or converted to a temporary file and opened with the program that the operating system associates with the file type. The file is written to `<temp>/sup-c_dcmviewer/`; files older than one day are removed at the next start. The source DICOM file is not changed.

Object	Conversion	Opened with
Encapsulated PDF	Encapsulated Document (0042,0011) is extracted (verified to start with `%PDF`)	default PDF program
Video (Transfer Syntaxes …4.100 – .108)	the compressed stream is written as `.mpg` (MPEG-2) or `.mp4` (others)	default video player
Structured Report	converted to a self-contained HTML page (§9.1)	default web browser
ECG and other waveforms	converted to an HTML page with SVG traces (§9.2)	default web browser

All text from DICOM files is HTML-escaped before it is written into a page.

9.1 Structured Reports

- The SR tree (Content Sequence) is rendered recursively to a depth of 24 and at most 20,000 items. Container items become sections; Text, Code, Numeric (with units), Date, Time, DateTime, Person Name and UID Reference items are shown as *name* | *value* rows; Image, Composite and Waveform references are shown as references (UID), Spatial and Temporal Coordinates as "coordinates". Relationship Types other than CONTAINS are shown as small labels. Templates (TIDs) are not evaluated.
- The header shows patient, study, series, report date, completion and verification flags and the SOP Class UID.
- If a report has no content items, the page says so and the number of referenced images (Current Requested Procedure Evidence Sequence) is given.
- **Radiation Dose SR** (X-Ray …88.67 and Radiopharmaceutical …88.68): in addition to the full report, a **summary** is generated with the accumulated totals found in the report (number of irradiation events, CT DLP total, DAP total, dose (RP) total, total fluoroscopy time; matched by code or by name) and a table of the irradiation events (*Irradiation Event X-Ray Data*, *CT Acquisition*) with protocol, event type, start time and all numeric values with units. Values are shown as stored; there is no unit conversion, dose evaluation or comparison with reference levels.

- Verification: ✅ Basic Text SR, Mammography CAD SR (real files) and X-Ray Radiation Dose SR (synthetic CT and projection layouts); 🔶 vendor-specific dose reports and other SR classes. Digital signatures in SR are not verified.

9.2 Waveforms (ECG and others)

- Sample values are computed as `raw × Channel Sensitivity × Channel Sensitivity Correction Factor + Channel Baseline` (PS3.3 C.10.9); 8/16/32-bit signed or unsigned samples; Waveform Padding Value becomes a gap in the trace. Every multiplex group of the object is shown (for example rhythm strip and median beat). ✅ values identical to pydicom for the 12-lead test file.
- Page layout: one trace per channel on ECG paper (1 mm and 5 mm grid, **25 mm/s, 10 mm/mV** for µV and mV channels, 1 mV calibration pulse, zero line, filter settings). Other units are scaled to fit and labelled with their range. At most the first 60 seconds of each channel are drawn; very long traces use a min/max envelope.
- ❌ Not supported: Waveform Annotations, µ-law / A-law waveforms, the clinical 3×4 lead layout (leads are stacked one per row), audio waveforms.

9.3 Video

Video is **not decoded** by the viewer. The compressed MPEG-2 / MPEG-4 / HEVC stream of the encapsulated Pixel Data is concatenated and handed to the system's video player. Playback requires a player and codecs on the computer. ✅ MPEG-2 (Video Endoscopic Image) extraction verified.

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10. Character sets

Text values are decoded according to **Specific Character Set (0008,0005)** when a file is parsed. The decoding is provided by the open-source `dicom-rs` library (version 0.10).

Specific Character Set	Status
(empty) / ISO_IR 6 (default repertoire)	✅
ISO_IR 100 (Latin 1)	✅
ISO_IR 192 (UTF-8: Latin, Greek, Cyrillic, Chinese, Japanese, …)	✅ verified with Greek, Cyrillic and Chinese names
ISO_IR 101, 109, 110 (Latin 2, 3, 4)	🔶
ISO_IR 144 (Cyrillic), 127 (Arabic), 126 (Greek), 138 (Hebrew), 166 (Thai)	🔶
ISO_IR 13 (JIS X 0201), ISO_IR 87 / ISO 2022 IR 87 (JIS X 0208 Japanese)	🔶
ISO_IR 149 / ISO 2022 IR 149 (Korean)	🔶
GB18030, GBK, GB2312 / ISO 2022 IR 58 (Simplified Chinese)	🔶
ISO_IR 148 (Latin 5), ISO_IR 159 (JIS X 0212)	❌
Multi-valued Specific Character Set with ISO 2022 code extension	🔶 best effort as implemented by the library

Display. The program uses the fonts of the computer (Segoe UI, Arial, Tahoma, Microsoft YaHei/JhengHei, Yu Gothic, Malgun on Windows; the equivalent system fonts on macOS and Linux) in addition to its built-in font. Characters that no installed font can draw appear as empty boxes. Right-to-left scripts (Hebrew, Arabic) are shown without bidirectional re-ordering.

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11. Security, privacy and data handling

Topic	Behaviour
Network	**None.** No connection is opened; no telemetry, update check or licence check.
Writing	The program **never writes** to the media or to the scanned folder. It writes **no** settings, logs, caches or other files. Exception: temporary files for document objects in `<temp>/sup-c_dcmviewer/` (§9)
Other programs	The program starts the operating system's file-opening mechanism (Windows `rundll32 url.dll,FileProtocolHandler`, macOS `open`, Linux `xdg-open`) to open a document object when the operator asks for it. It starts nothing else.

Topic	Behaviour
Patient data on screen	Patient name, ID, birth date and other attributes are shown on screen. There is **no anonymisation, export, print or clipboard function**. The temporary document files contain patient data and remain in the temp folder for up to one day.
Untrusted input	DICOM files are treated as untrusted. Every length and dimension is checked before memory is allocated; size limits: 4 GiB per file and 120 M pixels per frame (64-bit), 600 MiB and 40 M pixels (32-bit), JPEG-LS 2^28 samples per frame, 50 M waveform samples, 60 s of waveform drawn, SR depth 24 / 20,000 items, folder depth 32. Decoder panics are caught per image. 400 mutated files and 2,400 mutated JPEG-LS streams (plus every truncation length) produced no crash, hang or abort.
Access control, audit, encryption, digital signatures (MAC, signed SR)	❌ not provided
Data integrity	Files are read as stored; the viewer does not check the file-level checksum or Digital Signatures Sequence.

12. Configuration and operation

12.1 Command line and environment

```
sup-c_dcmviewer [folder] [--cache-mb N] [--timing]
```

Option	Meaning
`folder`	Scan this folder instead of searching for media automatically
`--cache-mb N` or environment variable `SUPC_VIEWER_CACHE_MB`	Size of the decoded-image cache in MB (64 – 65,536). Default: 1 GB (64-bit), 384 MB (32-bit)
`--timing`	Print scan and first-image timings to the error output
`SUPC_DEBUG_INPUT` (environment)	Debug output of input events

There are no configuration files and no persistent settings.

12.2 Automatic media discovery

If no folder is given, the program searches in this order and uses the first match:

1. a folder named `DICOM` (any case) **next to the executable**;
2. the executable's folder and up to three parent folders, for a `DICOMDIR` file or a `DICOM` folder (so that `<disc>\Windows\sup-c_dcmviewer.exe` finds `<disc>\DICOM`);
3. macOS: mounted volumes under `/Volumes` that contain a `DICOMDIR`.

When nothing is found the operator is asked to choose a folder.

12.3 Performance characteristics (informative)

Background decode workers (2–4), an LRU frame cache, and prefetching of the ±10 neighbouring frames of each viewport. Measured on a development machine: first image on screen typically within 0.05–0.13 s after start; decoding of one 512×512 frame: uncompressed 6–20 ms, JPEG 2000 7 ms, JPEG-LS (16-bit) 42 ms; 2048×2048 JPEG-LS 16-bit ≈ 0.7 s. Times for optical media depend on the drive.

12.4 Graphics requirement

The program draws with **OpenGL 2.0 or newer** and therefore needs a graphics driver. A computer that only offers the generic Windows display driver (for example a new virtual machine without guest tools / 3D acceleration) cannot start it; the program then shows a message box with the reason instead of closing silently. Windows does not need DirectX for the viewer.

13. Verification evidence

Details, file lists and numbers are in `VALIDATION.md`. Summary:

Area	Reference	Result
Uncompressed, JPEG, JPEG 2000, RLE pixel data	pydicom 3.0.2 with pylibjpeg (libjpeg, openjpeg, rle); all pydicom test files and synthetic JPEG files, frames 0–2	44 exact, 13 lossy within tolerance, 6 explicit "not supported" errors, **0 mismatches**
JPEG-LS (lossless and near-lossless)	CharLS 2.4.4 (pyjpegls, imagecodecs); 25 files / 33 frames: 8/10/12/16 bit, RGB, YBR, all interleave modes, signed, multi-frame	31 frames bit-exact; 2 YBR frames within ±1; a 2048×2048 frame identical
PALETTE COLOR	`pydicom.pixels.apply_color_lut`; 8 generated files + pydicom example, 11 frames	0 differences
ECG values	pydicom `waveform_array` for the 12-lead sample (2 groups)	identical (max abs. difference 0.0)
Radiation Dose SR	two generated reports (CT and projection layouts)	summary and event tables checked by tests
Robustness	corrupted and truncated streams	no panics or hangs
Automated test suite	50 unit and integration tests (`cargo test`)	all pass
Visual checks	GUI runs on real media (CT, MR, DX, mammography, tomosynthesis, ultrasound, UTF-8 names, PDF, MPEG, SR)	as described in the text

Not verified: JPEG-LS from scanners/PACS (only CharLS- and pydicom-made streams were available), vendor-specific Radiation Dose SR layouts, JPEG Lossless processes other than SV1, JPEG 2000 Part 2, character sets other than ISO_IR 100/192.

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14. Extensions, specializations and privatizations

- **Standard Extended / Specialized / Private SOP Classes:** none are defined.
- **Private data elements** are never interpreted; they are shown in the Tags window like any other element.
- **Private transfer syntaxes:** not supported.
- **Standard Extended Attributes** are not created because the viewer does not create DICOM objects.

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15. Known limitations (summary)

- Not network-capable; **DICOMDIR is not read** (the folder tree is scanned instead).
- No Modality LUT Sequence, VOI LUT Sequence, Presentation LUT, overlay, pixel padding, ICC profile handling; Presentation States only as simple graphics.
- 8-bit display, no display calibration: **not for diagnostic use**.
- JPEG Extended 12-bit, RLE 32-bit, HTJ2K, JPEG XL, float/double pixel data, indirect segmented palettes are not supported.
- No printing; no editable annotations; MPR/3D only for regular CT/MR volumes; export only as PNG (pixel data).
- Video, PDF, Structured Reports and waveforms are shown by other programs of the computer (temporary files).
- Waveform annotations and the clinical 12-lead layout are not available.
- Tomosynthesis, segmentation, RT and other specialised objects are shown (if at all) as raw pixel data without their specific semantics.

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16. Version 2.0 features

Feature	Behaviour	Status
Hanging protocols	Built in, no configuration files. Chosen from Modality, Image Type, Series Description, Image Position/Orientation (Patient), TR/TE/TI, Laterality and View Position. CT: largest axial series 4×4, scrollable; MR: T1, T2, FLAIR, DWI, ADC; MG: RCC, LCC, RMLO, LMLO back to back (mirrored from Patient Orientation); CR/DX: PA before lateral; US: images and cine loops. Enhanced multi-frame supported.	✅
MPR	CT / MR with one orientation and regular slice spacing; Image Position/Orientation (Patient) and Pixel Spacing, also per frame (Enhanced). Nearest-neighbour reslicing in RAM. No gantry tilt, no irregular spacing.	✅
3D volume rendering	CPU ray casting of the MPR volume, colour transfer functions, MIP / MinIP. Not a diagnostic rendering.	✅
Measurements	Distance, angle, ROI (area, mean, standard deviation, minimum, maximum) using Pixel Spacing; HU only for rescaled CT values; Imager Pixel Spacing marked '~'. Not stored.	✅
Radiation Dose SR	SOP Classes .88.67 and .88.68 with readable content are detected per study; the status bar shows an icon that opens the existing HTML report. No calculations.	✅
Key Object Selection	SOP Class .88.59: referenced images are marked and can be jumped to.	✅
GSPS	SOP Class 1.2.840.10008.5.1.4.1.1.11.1: POINT, POLYLINE, INTERPOLATED, CIRCLE, ELLIPSE and text in PIXEL or DISPLAY units.	🔶
Comparison	Active series next to the best matching series of another study of the same patient.	✅
PNG export	Current image or montage (pixel data only, chosen location). The only files the viewer writes besides temporary documents.	✅

17. Licence, ownership and branding

Freeware. Sup-C DCMviewer is owned by Patrick Cleys / Sup-C and is offered free of charge. The full terms are in `LICENSE.txt`, which is also built into the executable (About window → **View License**). This section is a summary; the licence text prevails.

Topic	Terms
Use	Free for private and professional use, on any number of computers, without time limit. No registration, activation, licence key, dongle, licence file, internet connection or licence server.
Distribution	Free redistribution of the **unmodified** software is allowed on any medium (CD, DVD, USB, download), also commercially (for example together with imaging studies). Fees for the physical medium or for your own services are allowed; selling the software itself as a stand-alone product requires written permission.
Not allowed	Modifying the executable; changing or removing the name, logo, icons, branding, version information, copyright notices or licence text; repackaging under another product name; reverse engineering (except where mandatory law permits it).
Ownership	The software, the name "Sup-C DCMviewer", "Sup-C", the logo and the icons remain the property of Sup-C. The source code is not published. No intellectual property rights are transferred.
Invitation	Commercial users are kindly invited to consider other Sup-C products and to mention Sup-C as the supplier. This is an invitation, not a payment obligation.
Intended use	Image review only. Not a medical device, not a certified diagnostic workstation, not for diagnostic use (see also the notice in the status bar and window title).
Warranty and liability	Provided without warranty and with limited liability, to the extent permitted by law (Belgian law; mandatory consumer law unaffected).
Third-party components	Keep their own licences, unchanged (Annex C, `LICENSES-THIRD-PARTY.md`, and **Third-party licences** in the About window).
Branding	Product name, logo, icon, copyright and licence text are built into the executable (window title, About window, Windows version resource); they cannot be changed by configuration files.

Topic	Terms
Website	www.sup-c.com

Integrity. The executable carries an Authenticode digital signature (Sup-C / Patrick Cleys) with an RFC 3161 timestamp; Windows verifies it. The program does not contain a self-check or any anti-tampering mechanism, which would conflict with portable use and antivirus compatibility. A copy whose signature is invalid or missing is not an original Sup-C release.

Annex A – Attributes read by the viewer

Group	Attributes (tag)	Use
Patient	Patient's Name (0010,0010), Patient ID (0010,0020), Birth Date (0010,0030), Sex (0010,0040)	tree, overlay, SR header
Study	Study Instance UID (0020,000D), Date (0008,0020), Time (0008,0030), Description (0008,1030), Accession Number (0008,0050)	tree, overlay
Series	Series Instance UID (0020,000E), Number (0020,0011), Description (0008,103E), Modality (0008,0060)	tree, overlay
Instance	SOP Class UID (0008,0016), SOP Instance UID (0008,0018), Instance Number (0020,0013), Acquisition Number (0020,0012), Number of Frames (0028,0008)	classification, ordering
Geometry	Image Position Patient (0020,0032), Image Orientation Patient (0020,0037), Slice Location (0020,1041), Pixel Spacing (0028,0030), Imager Pixel Spacing (0018,1164), Pixel Measures Sequence (0028,9110)	ordering, aspect ratio
Image Pixel	Samples per Pixel (0028,0002), Photometric Interpretation (0028,0004), Planar Configuration (0028,0006), Rows (0028,0010), Columns (0028,0011), Bits Allocated/Stored/High Bit (0028,0100–0102), Pixel Representation (0028,0103), Pixel Data (7FE0,0010)	decoding
Lossy	Lossy Image Compression (0028,2110)	warning
Modality LUT	Rescale Slope (0028,1053), Intercept (0028,1052), Type (0028,1054), Pixel Value Transformation Sequence (0028,9145), Modality LUT Sequence (0028,3000, presence only)	rescaling, warning
VOI	Window Center (0028,1050), Window Width (0028,1051), VOI LUT Function (0028,1056), Frame VOI LUT Sequence (0028,9132), VOI LUT Sequence (0028,3010, presence only)	window
Functional groups	Shared (5200,9229) and Per-Frame (5200,9230) Functional Groups Sequences	enhanced multi-frame values
Palette	0028,1101–1103, 1201–1203, 1221–1223	PALETTE COLOR
Documents	Encapsulated Document (0042,0011); SR: Value Type (0040,A040), Concept Name / Code sequences, Content Sequence (0040,A730), Text / Numeric / Date / Time / DateTime / Person Name / UID values, Completion / Verification flags, Evidence Sequence (0040,A375)	PDF, SR
Waveform	Waveform Sequence (5400,0100) with Number of Channels / Samples (003A,0005/0010), Sampling Frequency (003A,001A), Channel Definition Sequence (003A,0200) and its sensitivity, correction factor, baseline, units, filter and label attributes, Waveform Bits Allocated (5400,1004), Sample Interpretation (5400,1006), Padding Value (5400,100A), Waveform Data (5400,1010)	ECG
Text	Specific Character Set (0008,0005)	decoding

All other data elements are skipped, except that the Tags window can display them.

Annex B – SOP Class UID reference

SOP Class	UID
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-Ray Image Storage – For Presentation / For Processing	1.2.840.10008.5.1.4.1.1.1.1 / .1.1.1
Digital Mammography X-Ray Image Storage – For Presentation / For Processing	1.2.840.10008.5.1.4.1.1.1.2 / .1.2.1
Digital Intra-Oral X-Ray Image Storage – For Presentation / For Processing	1.2.840.10008.5.1.4.1.1.1.3 / .1.3.1
CT Image Storage / Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2 / .2.1
Ultrasound Multi-frame / Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.3.1 / .6.1
MR Image Storage / Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4 / .4.1
Secondary Capture (and multi-frame SC variants)	1.2.840.10008.5.1.4.1.1.7 (.1 – .4)
X-Ray Angiographic / Enhanced XA	1.2.840.10008.5.1.4.1.1.12.1 / .12.1.1
X-Ray Radiofluoroscopic / Enhanced XRF	1.2.840.10008.5.1.4.1.1.12.2 / .12.2.1
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3
Nuclear Medicine / PET / Enhanced PET	1.2.840.10008.5.1.4.1.1.20 / .128 / .130
VL Endoscopic / Microscopic / Photographic / Video Endoscopic image storage	1.2.840.10008.5.1.4.1.1.77.1.1 / .1.2 / .1.4 / .1.1.1
12-lead / General / Ambulatory ECG Waveform	1.2.840.10008.5.1.4.1.1.9.1.1 / .9.1.2 / .9.1.3
Hemodynamic Waveform	1.2.840.10008.5.1.4.1.1.9.2.1
Basic Cardiac Electrophysiology Waveform	1.2.840.10008.5.1.4.1.1.9.3.1
Arterial Pulse / Respiratory Waveform	1.2.840.10008.5.1.4.1.1.9.5.1 / .9.6.1
Basic Text SR / Enhanced SR / Comprehensive SR / Comprehensive 3D SR	1.2.840.10008.5.1.4.1.1.88.11 / .22 / .33 / .34
Mammography CAD SR / Key Object Selection / Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.50 / .59 / .65
X-Ray Radiation Dose SR / Radiopharmaceutical Radiation Dose SR	1.2.840.10008.5.1.4.1.1.88.67 / .88.68
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1

Annex C – Third-party components

The viewer is written in Rust and is a single executable. Principal components (full list with licences in `LICENSES-THIRD-PARTY.md`):

Component	Use	Licence
dicom-rs (`dicom-object`, `dicom-encoding`, `dicom-pixeldata`, …) 0.10	DICOM parsing, character sets, RLE and JPEG-Lossless decoding	MIT OR Apache-2.0
zune-jpeg	JPEG Baseline / Extended decoding	MIT OR Apache-2.0 OR Zlib
jpeg2k / openjp2 (pure-Rust OpenJPEG port)	JPEG 2000 decoding	MIT/Apache-2.0, BSD-2-Clause
JPEG-LS decoder (`src/jpegls/`) derived from `radicom-codecs-jpeg-ls` 0.1.2	JPEG-LS decoding	MIT
egui / eframe	user interface	MIT OR Apache-2.0
rfd	native folder dialog	MIT
rayon	parallel pixel conversion	MIT OR Apache-2.0

No component is linked dynamically except operating-system libraries (graphics, windowing). No C or C++ codec is used.

This software is for image review only. It is not a certified diagnostic workstation and is not a medical device.