

DOC-2026-099 v6 — XyDromatics Migration Engine — DICOM Conformance Statement

Document number: DOC-2026-099 **Title:** XyDromatics Migration Engine — DICOM Conformance Statement
Version: v6 **Category:** DICOM Conformance Statement **Product:** XyDromatics Migration Engine **Release version:** 1.0.3.179 **Classification:** Non-device software (FD&C Act §520(o)(1)(D)) **Owner:** Synthology Healthcare Solutions Group, LLC (SHSG) **Effective date:** (on approval) **Review cycle:** 1 year **Next review due:** TBD
Supersedes: DOC-2026-099 v4 — updated to the 1.0.2.176 GA. Adds Federated Query/Retrieve (C-FIND SCU fan-out across multiple source archives with retrieve-through-the-engine to a target) to the SCU conformance sections; refreshes the DICOM stack version and product release references. Device posture unchanged: non-device software under FD&C Act §520(o)(1)(D). (v2/v3/v4 lineage: §10 companion-documents reference and §11 Conformance Claim reflect the 2026-04-19 reclassification of the Migration Engine to non-device software under FD&C Act §520(o)(1)(D) per DOC-2026-097 v2.); v6 (2026-08-06) — GA release alignment to XyDromatics Migration Engine 1.0.3.179 (RI-2026-486 / DCR-2026-2274), no substantive content change.

1. Introduction

1.1 Purpose

This document describes the DICOM conformance of the XyDromatics Migration Engine in accordance with **NEMA DICOM Standard PS3.2 (Conformance)**. It enumerates the DICOM services supported, the SOP classes implemented, the networking characteristics, and the extensions, specializations, and privatizations that apply.

1.2 Intended Readers

- Integration engineers validating the Migration Engine against source/target archives
- Hospital PACS administrators planning a migration project
- Reviewers assessing DICOM equivalence to the reference implementation (XyDromatics Router)
- Synthology Technical Support

1.3 Scope

The Migration Engine acts in four DICOM roles:

1. **SCU (Service Class User)** for querying and retrieving studies from **source** archives (C-FIND, C-MOVE, C-ECHO).
2. **SCU (Service Class User)** for **Federated Query/Retrieve** — fanning a single C-FIND across **multiple** configured source archives concurrently, then retrieving the matched studies **through the engine** to a configured target (C-FIND, C-MOVE, C-ECHO). See §3.5.
3. **SCU (Service Class User)** for storing studies to **target** archives (C-STORE, STOW-RS, C-ECHO).
4. **SCP (Service Class Provider)** for receiving pushed studies in **receive-mode** ingestion (C-STORE, C-ECHO) — *license-gated by `dicom_scp_receive`*.

2. Networking

2.1 Implementation Model

Conformance Statement applies to:

- **Product:** XyDromatics Migration Engine
- **Version:** 1.0 (release 1.0.3.179)
- **Runtime:** .NET 8 self-contained (Windows-x64 and Linux-x64 native)
- **DICOM stack:** fo-dicom 5.2.5

2.2 Ports

Role	Default Port	Configurability	Licensing
DICOM SCP (receive-mode)	11116	Configurable via <code>dicom_scp_port</code>	<code>dicom_scp_receive</code> — listener bound only when licensed
Web UI / REST API	5102	Configurable via <code>web_port</code>	Base license
Outbound SCU	N/A (dynamic source ports)	—	—

2.3 Application Entity Titles

AE Role	Default	Max Length	Notes
ME Calling AE (SCU mode)	<code>MIG_ENGINE</code>	16	Per PS3.5 §6.2; used when the ME acts as SCU (including federated query/retrieve)
ME Called AE (SCP mode)	<code>MIG_ENGINE</code>	16	Used when the ME accepts associations (including C-MOVE retrieve-through)
Source-project Calling AE whitelist	Per-project list	16 each	Only whitelisted peers may initiate C-STORE in receive-mode
Global Calling AE whitelist	Global list	16 each	Applied as fallback when per-project whitelist is empty

2.4 Association Parameters

Parameter	Value
Maximum PDU Size (requested)	16 384 bytes
Maximum PDU Size (accepted)	Up to 131 072 bytes
Maximum Operations Invoked	1
Maximum Operations Performed	1
Asynchronous Operations Window	Not supported
Implementation Class UID	1.2.826.0.1.3680043.9.7274.3.1.0
Implementation Version Name	XYDROMATICS_ME_1_0

2.5 Transport

- TCP/IP over IPv4 and IPv6.
- TLS on DICOM associations: **not supported in v1.0** (roadmap for v1.1). TLS **is** supported on the HTTPS web and STOW-RS interfaces.

3. SCU Conformance — Source Archive Query/Retrieve

3.1 Supported SOP Classes (Association Initiator)

SOP Class Name	SOP Class UID	Role
Verification	1.2.840.10008.1.1	SCU (C-ECHO to test source)
Study Root Query/Retrieve Information Model — FIND	1.2.840.10008.5.1.4.1.2.2.1	SCU (per-archive and federated fan-out)
Study Root Query/Retrieve Information Model — MOVE	1.2.840.10008.5.1.4.1.2.2.2	SCU (single-source and retrieve-through)

3.2 C-FIND Behavior (Study-Level)

The Migration Engine initiates Study-level C-FIND associations against configured source archives to enumerate studies for migration. Supported query keys:

Tag	Attribute	Support
(0008,0020)	StudyDate	Match range (YYYYMMDD-YYYYMMDD)
(0008,0030)	StudyTime	Not used in query; returned verbatim
(0008,0050)	AccessionNumber	Exact match
(0008,0060)	Modality (from ModalitiesInStudy)	Exact match
(0008,0090)	ReferringPhysicianName	Wildcard *
(0010,0010)	PatientName	Wildcard *
(0010,0020)	PatientID	Exact match
(0010,0030)	PatientBirthDate	Exact match
(0020,000D)	StudyInstanceUID	Unique key, exact match
(0020,0010)	StudyID	Exact match
(0020,1206)	NumberOfStudyRelatedSeries	Returned only
(0020,1208)	NumberOfStudyRelatedInstances	Returned only

Relational queries are not used (Hierarchical Q/R only).

3.3 C-MOVE Behavior

The Migration Engine issues Study-level C-MOVE requests with **itself** as the MOVE destination. The receiving SCP's SCP (typically the configured source archive) must be pre-provisioned with the ME's Called AE + IP for this to succeed. C-MOVE responses are streamed into the ME's SCP which persists instances to the staging directory.

3.4 Parallelism

Concurrent C-MOVE operations are controlled by the `parallel_cmove` license feature and the `SemaphoreSlim` configured from `max_parallel_cmove` in project settings. Base tier: 1 concurrent. Licensed: configurable up to 8.

3.5 Federated Query/Retrieve

Federated Query/Retrieve (license feature `federated_qr`; permissions `view_federation` / `manage_federation`) lets an operator issue **one** Study-level C-FIND that the engine **fans out** to multiple configured source archives concurrently, aggregates the per-archive match sets (de-duplicated by StudyInstanceUID, with the responding source AE retained for provenance), and then retrieves selected matched studies **through the engine** to a configured target.

- **Query fan-out (C-FIND SCU).** The engine opens an independent Study-Root C-FIND association to each participating source archive using the SOP class and query keys of §3.1/§3.2. Per-archive failures are isolated: an archive that rejects the association or times out is reported in the aggregated result without failing the other archives' matches.
- **Retrieve-through (C-MOVE SCU + internal C-STORE SCP + forward).** For each selected study the engine issues a Study-level C-MOVE to the study's originating source archive with **itself** as the MOVE destination (per §3.3), receives the instances into staging via its internal C-STORE SCP, and then forwards them to the configured target using the SCU storage path of §4 (C-STORE SCU or STOW-RS). Source-to-target transfer-syntax propagation and the no-transcoding rule of §4.2 apply unchanged.

- **SOP classes / roles.** No new SOP classes are introduced. Federation uses Study Root Q/R FIND (1.2.840.10008.5.1.4.1.2.2.1 , SCU) for the fan-out and Study Root Q/R MOVE (1.2.840.10008.5.1.4.1.2.2.2 , SCU) for retrieval, with the engine acting as C-MOVE destination via its own Storage SCP (§5) and as Storage SCU to the target (§4).
- **Provenance.** The originating source AE is preserved in the federated match set so the operator can see which archive each candidate study came from before retrieval.

4. SCU Conformance — Target Archive Storage

4.1 Supported SOP Classes (Storage)

The Migration Engine will store any SOP class it receives into its staging directory, provided the target archive negotiates the same Presentation Context. Representative Storage SOP classes are enumerated below; full list is identical to the Router (see DOC-2026-074 §4) and includes:

Category	Representative SOP Class UIDs
Image Storage	CT 1.2.840.10008.5.1.4.1.1.2 , MR .4 , CR .1 , DX Presentation .1.1.1 , DX Processing .1.1.1.1 , US .6.1 , XA .12.1 , XRF .12.2 , NM .20 , PT .128 , SC .7 , Mammography .1.2
Video Storage	.1.2.1 (Video Endoscopic), .1.77.1.4.1 (Video Photographic)
Presentation State	GSPS .11.1 , Color Softcopy PS .11.2 , Pseudo-Color .11.3
Structured Reports	Basic Text SR .88.11 , Enhanced SR .88.22 , Comprehensive SR .88.33 , Mammography CAD SR .88.50 , Chest CAD SR .88.65
Waveform	12-lead ECG .9.1.1 , General ECG .9.1.2 , Ambulatory ECG .9.1.3 , Hemodynamic .9.2.1
Radiotherapy	RT Image .1.481.1 , RT Dose .1.481.2 , RT Structure Set .1.481.3 , RT Plan .1.481.5
Encapsulated	Encapsulated PDF .104.1 , Encapsulated CDA .104.2 , Encapsulated STL .104.3
Whole Slide Imaging	VL Whole Slide Microscopy Image .77.1.6

4.2 Transfer Syntaxes (Proposed as SCU)

Transfer Syntax	UID	Proposed
Implicit VR Little Endian	1.2.840.10008.1.2	Yes (fallback)
Explicit VR Little Endian	1.2.840.10008.1.2.1	Yes (preferred)
JPEG Baseline 1	1.2.840.10008.1.2.4.50	Yes
JPEG Lossless NH FOP	1.2.840.10008.1.2.4.70	Yes
JPEG 2000 Lossless	1.2.840.10008.1.2.4.90	Yes
JPEG 2000 Lossy	1.2.840.10008.1.2.4.91	Yes
RLE Lossless	1.2.840.10008.1.2.5	Yes
Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99	Yes

The Migration Engine does **not** perform pixel-data transcoding. Transfer syntax is propagated from source to target (including on the retrieve-through path of §3.5); if the target rejects the presented syntax, the study fails with an operator-visible error.

4.3 STOW-RS Target

When the target is configured as STOW-RS (DICOMweb), the ME POSTs `multipart/related; type="application/dicom"` per PS3.18 §10.5. HTTP Basic Auth or bearer token is supported per target configuration.

4.4 C-STORE SCU Batching

Instances are batched per study; the batch size is controlled by `target_batch_size` (default 10 instances). On batch failure, the batch is retried up to `target_retry_count` (default 3) with exponential backoff.

5. SCP Conformance — Receive-Mode Ingestion

5.1 License Gating

The C-STORE SCP listener on port 11116 is bound **only if** `LicenseManager.IsFeatureLicensed("dicom_scp_receive")` returns true at startup. Unlicensed deployments cannot be used as C-STORE receivers and return no response on TCP connection attempts to 11116. (The same internal Storage SCP receives C-MOVE responses on the retrieve-through path of §3.5 and single-source C-MOVE of §3.3.)

5.2 Supported SOP Classes (Association Acceptor)

The Migration Engine accepts any Storage SOP class enumerated in §4.1, plus Verification (`1.2.840.10008.1.1`).

5.3 Association Acceptance Rules

On association request:

1. **Calling AE Title check.** The ME looks up the project(s) that have `source_kind = "receive"`. The calling AE must match:
2. An entry in the project's per-source calling-AE whitelist, OR
3. An entry in the global calling-AE whitelist (fallback when project whitelist is empty).
4. **Rejection.** Unmatched calling AE → association rejected with Result=3 (Rejected-Permanent), Source=1 (Service User), Reason=1 (No Reason Given).
5. **Presentation Context acceptance.** Any Storage SOP class + any proposed Transfer Syntax is accepted. Verification is always accepted.

5.4 Quiescence / Batch Flip

Received instances are persisted to staging and associated with their project's `receive-mode` batch. A study enters state `receiving` on first instance. When no new instance arrives for that Study UID within the configured quiescence interval (default 120 seconds), the study flips to `queued` and becomes eligible for the normal migration pipeline (transforms → quality gates → target forward).

6. Data Transformation Behavior

6.1 License Gating

Transformation rules are applied **only when** `LicenseManager.IsFeatureLicensed("data_transforms")` returns true. Unlicensed deployments bypass the rule engine entirely; received/pulled studies forward byte-for-byte to the target.

6.2 Transform Pipeline

When licensed, each study passes through:

1. **TagMorph** — rule-based DICOM attribute transformation (date reformatting, address blanking, code mapping). Rules are administrator-configured per project.
2. **Normalize** — pattern-based harmonization of variant representations (e.g., `03/14/2025` → `20250314`).

Both stages are implemented in `Synthology.Shared.Dicom.TransformPipeline`, the same library used by the XyDromatics Router (reference implementation).

6.3 Quality Gates

Quality-gate outcomes are evaluated at the **study** level: the worst outcome across all instances in a study holds or fails the whole study. A study that fails a gate is moved to an on-disk `hold_queue` and is not forwarded to the target. Gate evaluation is a pipeline stage between transforms and target forward; there is no in-app review/release workflow — held studies remain on disk for out-of-band operator handling.

6.4 User Controls

- **Preview dry-run.** `POST /api/projects/{id}/transforms/preview` applies rules to a single study and returns before/after diffs without mutating.
- **Administrator-only editing.** `TransformsController` endpoints require `admin` role.

- **Audit trail.** Every applied rule is logged to the project's event stream with source/target tag values.
- **Per-rule severity.** Rules tagged `error` halt the study; `warn` continues with event logged.

7. Extensions, Specializations, Privatizations

- **None.** The Migration Engine does not add any private tags, does not extend any SOP class, and does not privatize any IOD. All DICOM compliance is standard. Federated Query/Retrieve (§3.5) is composed entirely from standard Study Root Q/R FIND/MOVE and standard Storage services — it introduces no private negotiation or non-standard behavior.

8. Configuration

8.1 Configuration File

`migration_engine_config.json` at `{DataDir}/migration_engine_config.json` :

Key	Default	Description
<code>ae_title</code>	<code>MIG_ENGINE</code>	ME's own AE title
<code>dicom_scp_port</code>	11116	Receive-mode SCP port
<code>dicom_scp_enabled</code>	<code>true</code>	Enable SCP listener (also gated by license)
<code>web_port</code>	5102	REST API / UI port
<code>parallel_cmove</code>	1	Concurrent C-MOVE count (licensed feature caps at 8)
<code>global_receive_whitelist</code>	<code>[]</code>	Global calling-AE whitelist
<code>quiescence_seconds</code>	120	Receive-mode batch flip interval

8.2 Per-Project Source Configuration

- Source kind: `query` (C-FIND/C-MOVE), `receive` (C-STORE SCP), or `federated` (multi-archive C-FIND fan-out + retrieve-through, §3.5).
- Source endpoint(s): AE title + host + port + calling AE (ours). Federated projects list multiple source endpoints.
- Source whitelist (receive-mode only).
- C-FIND filters (modality, date range, patient selectors).

8.3 Per-Project Target Configuration

- Target type: `cstore` (C-STORE SCU) or `stow` (STOW-RS POST).
- Target endpoint.
- Target auth (STOW-RS only): basic or bearer.
- Batch size and retry policy.

9. Support of Character Sets

- Default Character Set (ISO-IR 6).
- Latin alphabets No. 1–5 (ISO_IR 100 , ISO_IR 101 , ISO_IR 109 , ISO_IR 110 , ISO_IR 144).
- Unicode UTF-8 (ISO_IR 192).

Multi-valued Specific Character Set (ISO 2022) is passed through unchanged; the ME does not transcode.

10. Security & Privacy

Refer to DOC-2026-098 (ME Penetration Test Documentation) and DOC-2026-097 v2 (ME Non-Device Determination Memo) for:

- Authentication & session security
- Audit logging (HIPAA-baseline)
- Network security posture
- License-gate enforcement points

Support-role sessions are gated **out** of patient data (HTTP 403 on patient-data surfaces), not masked.

11. Conformance Claim

The XyDromatics Migration Engine v1.0 (release 1.0.3.179) is designed to conform to **NEMA DICOM PS3 (2024b)** as specified in this Conformance Statement. Field conformance testing against reference archives (Dicoogle, dcm4chee-arc-light 5.32, Orthanc 1.12, Synapse PACS, Centricity) — including the Federated Query/Retrieve fan-out and retrieve-through path — is performed under the Migration Engine V&V plan (DOC-2026-102 v5 §9). The Migration Engine is non-device software under FD&C Act §520(o)(1)(D) — software that transfers, stores, converts, and forwards medical-imaging data and performs no clinical function; see DOC-2026-097 v2 for the determination rationale. Downstream diagnostic use of studies processed by the Migration Engine occurs on separate systems (see DOC-2026-113 v1).

Conformance Statement Approved By: *(pending SynthQMS approval)* **Date:** 2026-08-03

Regulatory classification. Non-device software under the FD&C Act §520(o)(1)(D) software exclusion. This statement is published by Synthology Healthcare Solutions Group, LLC as a controlled document; the authoritative version is the approved record in the Synthology quality-management system.