OPCITO TECHNOLOGIES

CZI to DICOM Medical Imaging Conversion Pipeline

About The Customer

The customer is a HealthTech organization operating at the intersection of laboratory imaging and clinical informatics. Their platform is designed to automate the conversion of proprietary microscopy image files into universally compatible DICOM format — eliminating manual imaging workflows, enabling interoperability across clinical PACS systems, and delivering standardized, AI-ready imaging data for downstream diagnostics across both cloud and on-premises laboratory environments.

Business Challenge

The customer faced significant challenges in operationalizing microscopy imaging data for clinical and AI-driven use cases. As imaging workflows scaled, the reliance on proprietary CZI format created systemic barriers to interoperability, data integrity, and diagnostic readiness.

- Microscopy images were locked in a proprietary CZI format incompatible with clinical PACS systems, DICOM viewers, and AI diagnostic platforms — limiting their utility beyond the point of acquisition.
- Critical imaging metadata, including channel wavelengths, optical configurations, Z-stack parameters, and acquisition settings, was lost during manual export processes, compromising data fidelity.
- No standardized pipeline existed to support multi-resolution image delivery, concurrent processing, or end-to-end audit tracking — creating operational gaps and scalability constraints.

How Opcito Helped

Opcito partnered with the customer to design and implement a production-ready, automated imaging conversion pipeline that transforms proprietary CZI microscopy files into clinically interoperable DICOM format — preserving complete imaging metadata and enabling scalable, observable processing across cloud and on-premises environments.

- **Streaming microservice architecture:** Architected a Python FastAPI microservice with a 7-step streaming pipeline to convert CZI files into multi-frame DICOM format, ensuring end-to-end automation of the imaging workflow.

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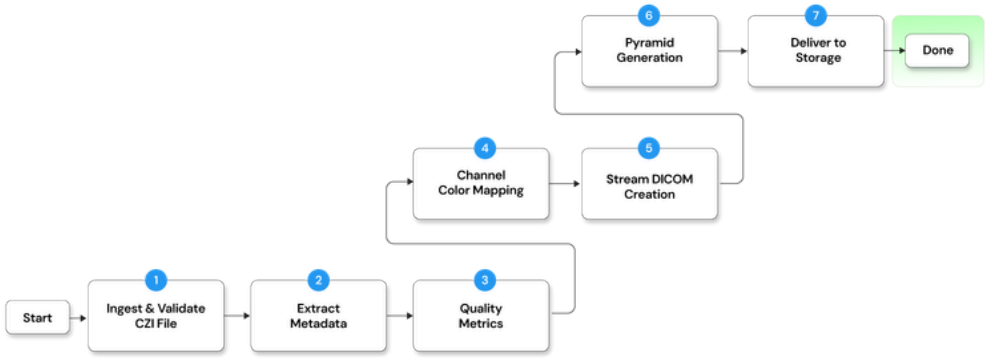
How Opcito Helped

- **Complete metadata preservation:** Engineered full retention of imaging metadata — including channel mappings, histograms, SNR values, and acquisition parameters — via DICOM private tags, ensuring no diagnostic context is lost during conversion.
- **Memory-safe frame processing:** Implemented a streaming DICOM writer that processes frames in 5-frame batches, capping peak memory consumption at 4.5 GB regardless of input file size, with DICOM undefined-length encoding for files exceeding 4 GB.
- **Multi-resolution DICOM pyramid generation:** Built dynamic 3-level image pyramid generation using geometric-mean scale targeting, enabling multi-resolution delivery suited for clinical viewing and AI model consumption.
- **Interchangeable storage abstraction:** Designed a factory-pattern storage layer supporting both AWS S3 and on-premises filesystems interchangeably, enabling flexible deployment across hybrid environments.
- **Audit and observability integration:** Integrated RabbitMQ-based audit events at each pipeline step alongside PostgreSQL job tracking, delivering full operational observability across the conversion lifecycle.
- **Concurrent job execution:** Configured the pipeline to support up to 5 parallel conversion jobs, enabling scalable throughput for high-volume laboratory imaging environments.



Technologies, Tools, and Platforms used

PYTHON

FASTAPI

RABBITMQ

PYDICOM

Benefits

AUTOMATED IMAGING WORKFLOW	End-to-end automation of the CZI-to-DICOM conversion process eliminates manual intervention, reducing processing time and operational overhead across laboratory environments
CLINICAL DICOM INTEROPERABILIT	Standardized DICOM output ensures seamless compatibility with PACS systems and clinical DICOM viewers, enabling imaging data to flow freely across healthcare infrastructure

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Benefits

DOWNSTREAM DIAGNOSTIC COMPATIBILITY	AI-ready, metadata-rich DICOM files support direct integration with diagnostic platforms and machine learning pipelines, accelerating the path from image acquisition to clinical insight

About Opcito

At Opcito, we believe in designing transformational solutions for our customers, start-ups, and enterprises, with our ability to unify quality, reliability, and cost-effectiveness at any scale. Our core work culture focuses on adding material value to your products by leveraging best practices in DevOps, like continuous integration, continuous delivery, and automation, coupled with disruptive technologies like containers, serverless computing, and microservice-based architectures. We also believe in high standards for quality with a zero-bug policy and zero downtime deployment approach.

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