
DICOM WG-26 Annotation Connectathon

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Vilnius, Lithuania



ESDIP
EUROPEAN SOCIETY OF DIGITAL AND INTEGRATIVE PATHOLOGY
ecdp2024.org

DICOM Working Group 26 Needs You

What we do: review changes proposals, run connectathons, and other functions to advance the DICOM standard.

- New Co-Chairs:
 - Brian Napora (Gestalt Diagnostics)
 - Dr. Mustafa Yousif MD (University of Michigan)

Working group 26 meets virtually 3rd Tuesday of the month 9:00 AM Central Standard Time (UCT-6).

- Interested in becoming involved email: Kevin Schap (kschap@cap.org)

Overview

- Overview of the connectathon.
- Interoperability, DICOM, and annotations
- Microscopy Bulk Simple Annotation
- Connectathon design and participants
- Example imaging
- Results and take away messages.

2024 Connectathon Goals

Test cross vendor interoperability of annotations using DICOMweb and the DICOM Microscopy Bulk Simple Annotation IOD.

High Level Summary

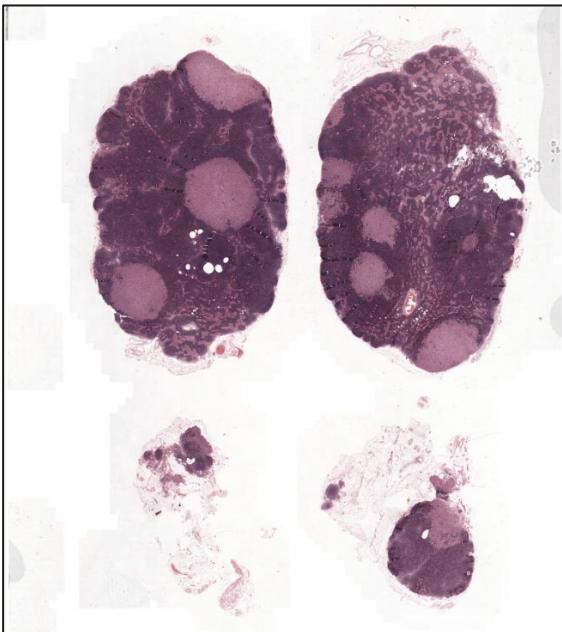
Successfully generated, stored, retrieved, and viewed Digital Pathology Annotations in DICOM (Participants N=11).

Why is interoperability important?

- Ability to use software which best meets the needs.
- Ensures that findings can be generated once and communicated and reused for unanticipated use cases.
- Increases confidence that artifacts are not vendor dependent.

DICOM

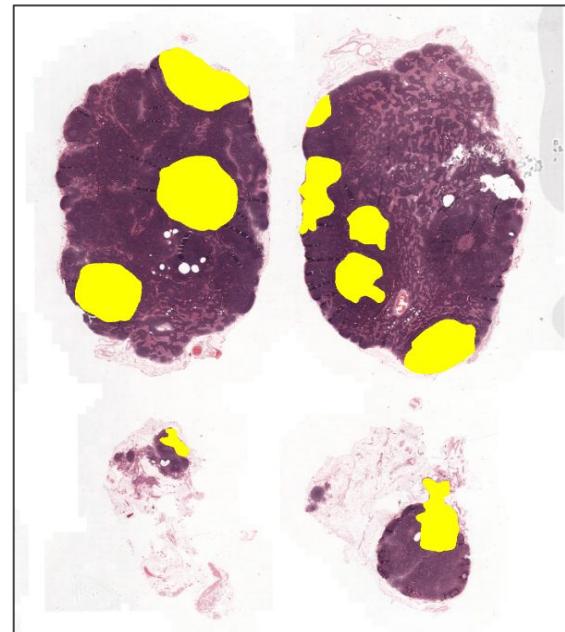
Imaging



Structured metadata

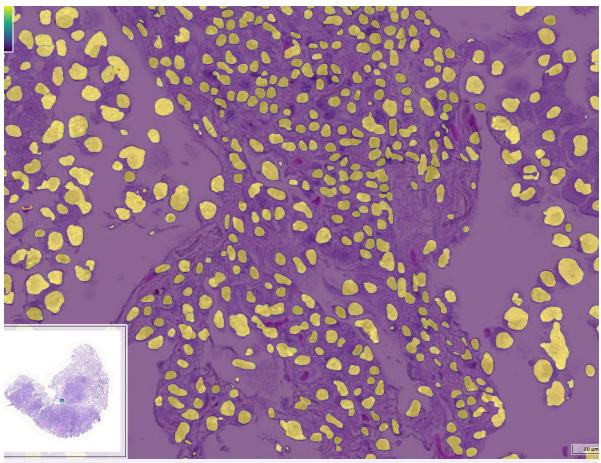
- Patient
- Provider
- Exam
- Sample
- Image
- etc.

Imaging Annotations

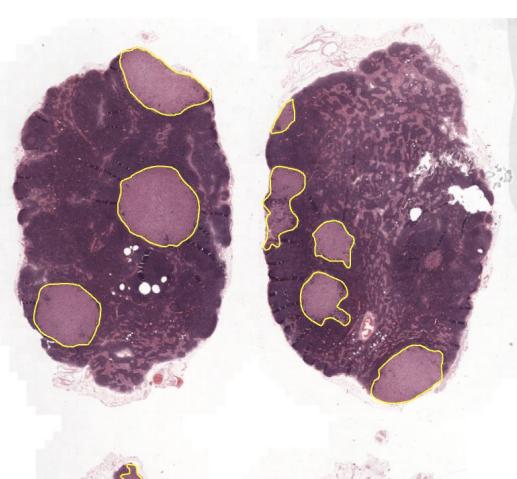


DICOM Defines Multiple IODs for Annotation

DICOM Segmentations



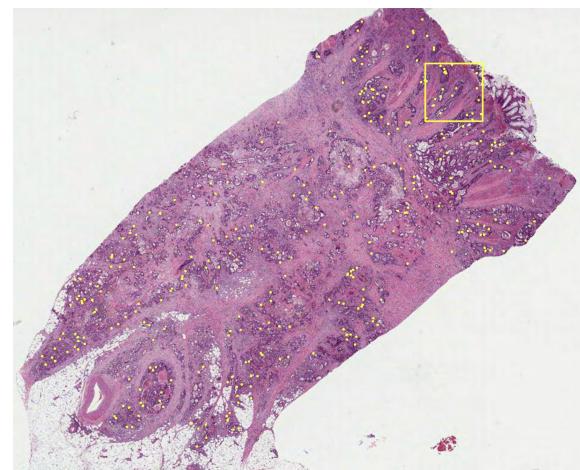
Structured Reports



- Raster
- Optionally
 - Represent as pyramid
 - Multi-frame

- Highly flexible combine text, vector graphics, and references to raster images.

Bulk Microscopy Simple (2021)



- Resolution independent (vector graphics)
- Points, lines, polygons, rectangles, ellipse
- Designed for ML use cases.

Microscopy Bulk Simple Annotations Overview

- Annotations reference source imaging but do not alter the source imaging.
- Defined in same Study Instance UID as source imaging, new Series Instance UID; Modality = ANN.
- Efficiently store vector graphics annotations (Points, Lines, Rectangles, Ellipses, Polygons)
- Annotations optimized to represent multiple annotations of the same graphics type for the same type of object. e.g., location of specific cell type, perimeter of tissue type, area of issue, etc.
- Supports 2D (pixel coordinate relative) and 3D (mm) slide coordinates and embedding pre-computed measurements.
- Annotation coordinates (OF or OD) and indices (OL) encoded using binary VR codes. DICOM stores may support bulk data retrieval of binary tag values via DICOM web.

https://dicom.nema.org/medical/dicom/current/output/chtml/part03/sect_A.87.3.html

Connectathon Parameters

- Source imaging: VL Whole Slide Microscopy Image
 - Tiled full
 - Single focal plane
 - Single instance per pyramid level (not concatenated)
- Annotations: Microscopy Bulk Simple Annotations (IOD)
 - 2D (Annotation coordinates defined as pixel coordinates)
 - Volume (Annotations defined in reference to pyramid level)
- Imaging stored / retrieved: DICOMweb
- Annotation creators provided ground truth imaging used to validated viewers.

Participants

Creators (N=10)

- 3DHISTECH
- AIRAmatrix
- Emory caMicroscope
- Gestalt
- Google
- Identify.bio
- Imaging Data Commons (IDC)
- National Taipei University of Nursing and Health Sciences (NTUNHS)
- Pramana
- Techcyte

Archives (N=2)

- Google
- J4Care

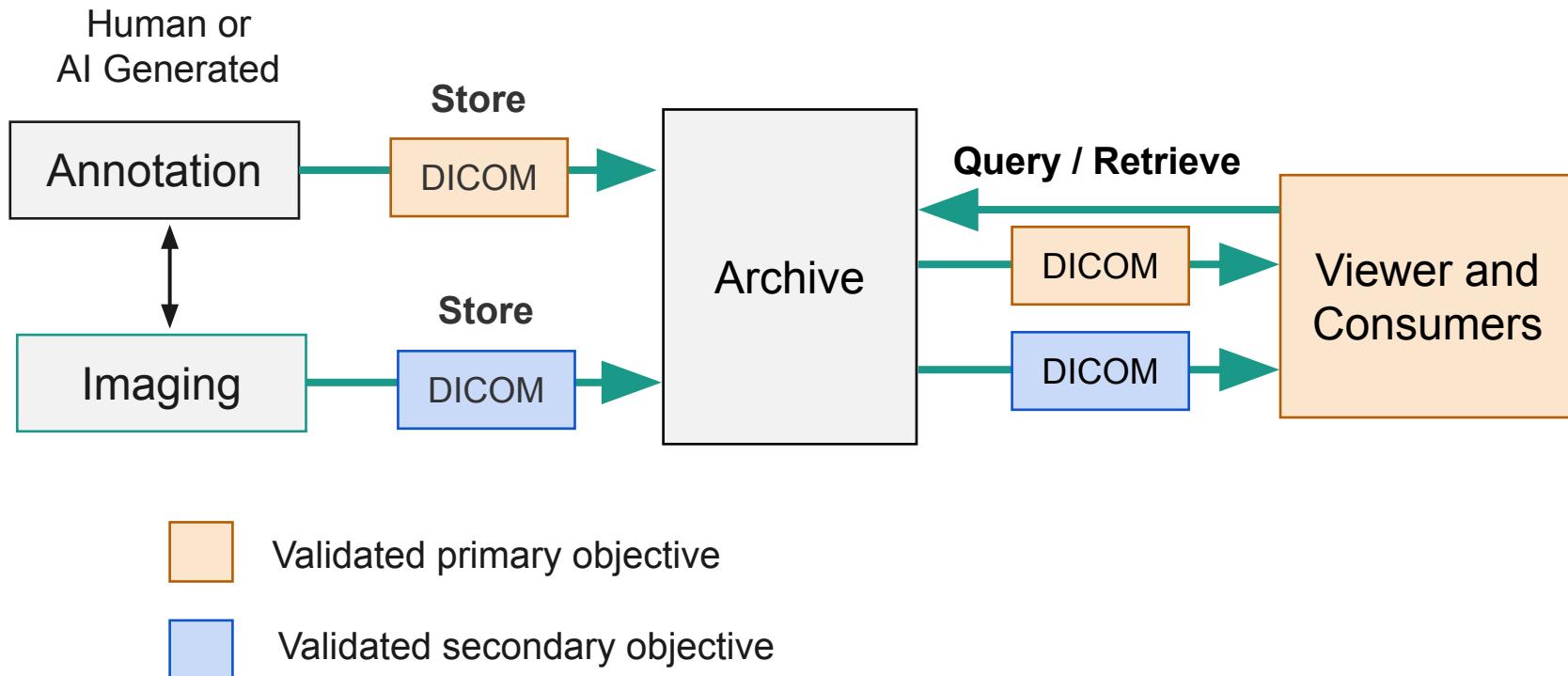
Viewers (N=7)

- Emory caMicroscope
- Gestalt
- Google
- Imaging Data Commons (IDC)
- J4Care
- National Taipei University of Nursing and Health Sciences (NTUNHS)
- Techcyte

Consumer (N=1)

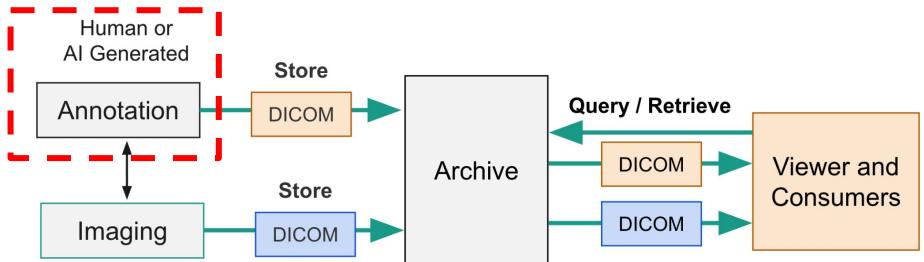
- Imaging Data Commons (IDC)

Connectathon Design



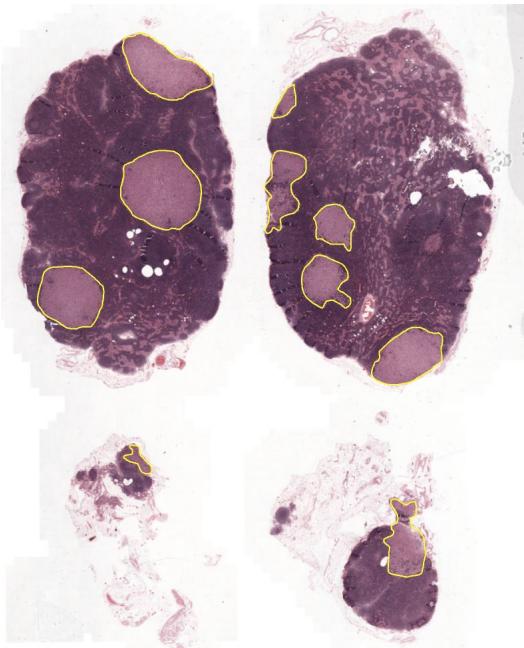
Annotations tested

- 20 Annotations from 10 vendors tested.
- All annotation graphics types used.
- Total number of annotations (1 - 300,000+)
- Annotations generated with reference to highest magnification (most common) and downsampled pyramid levels.
- DICOM validated (dciodvfy)

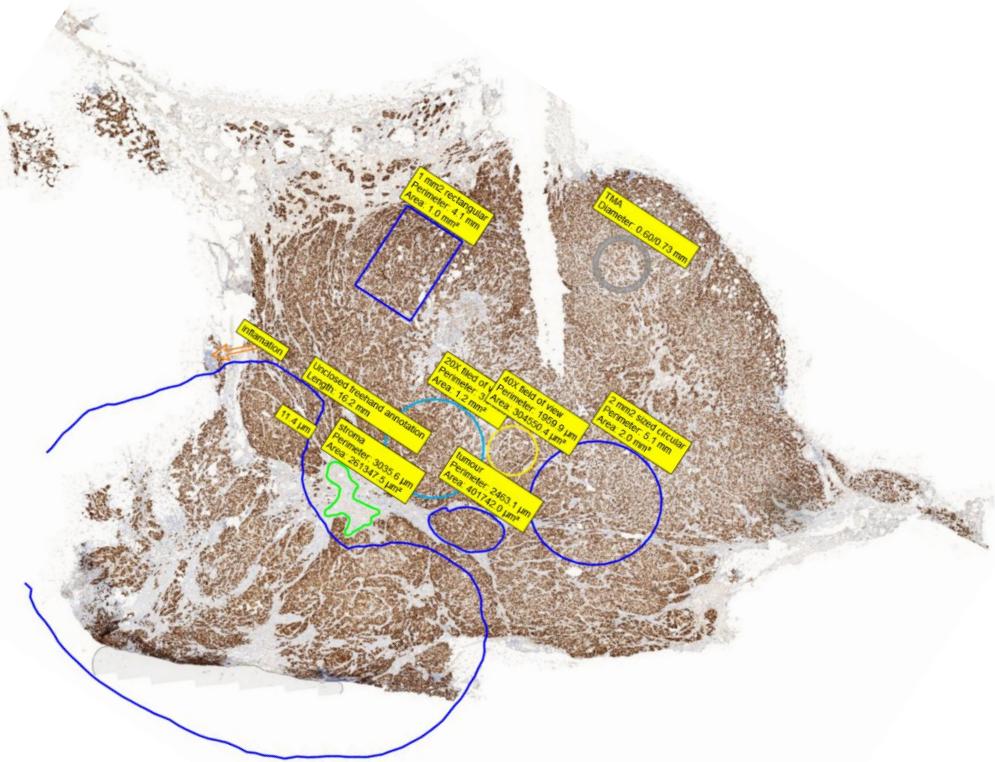


Examples of tested annotations follow.

Examples of Annotations

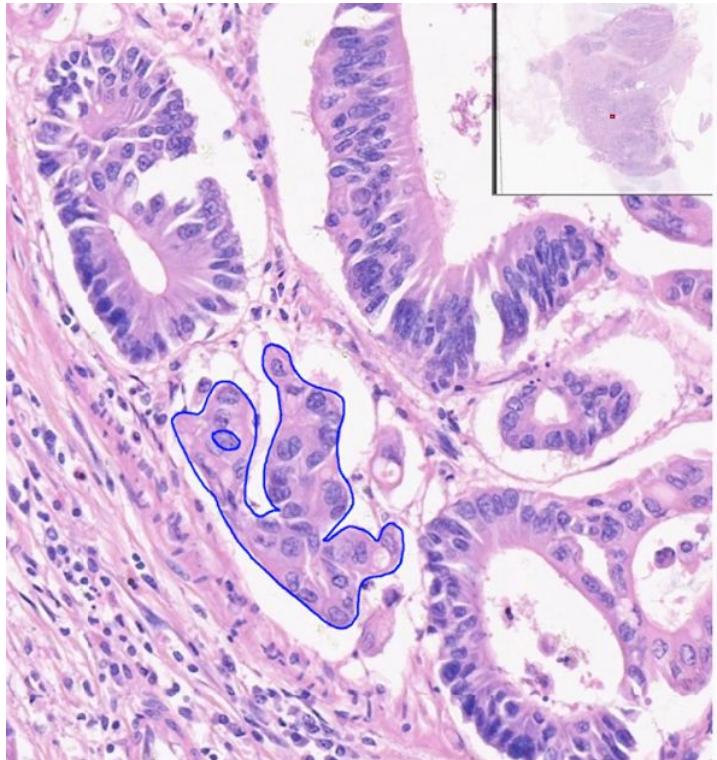
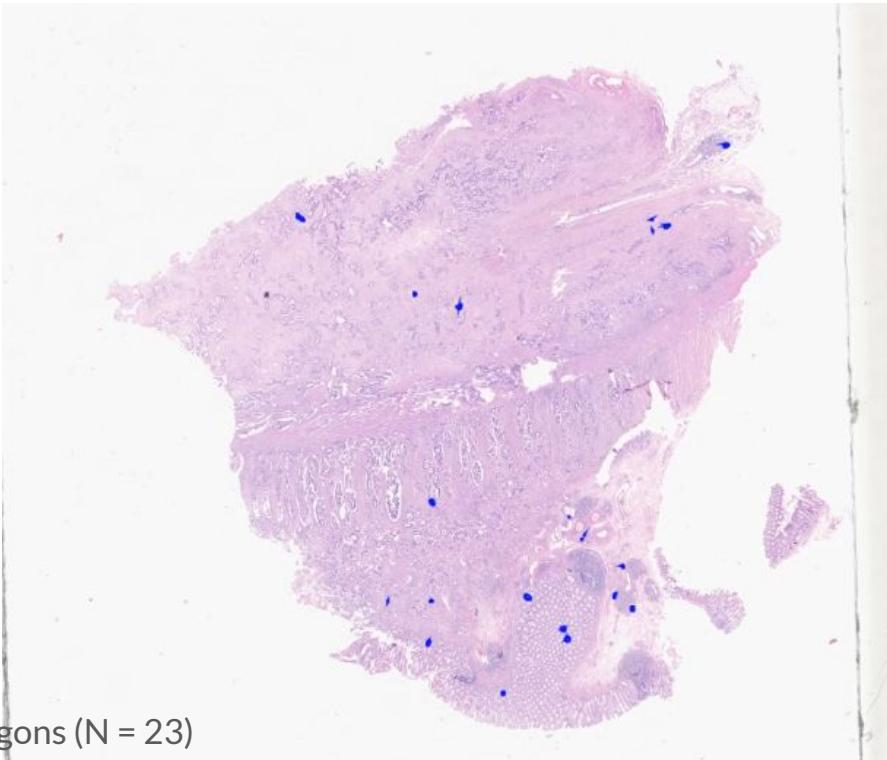


Polygons (N = 10)

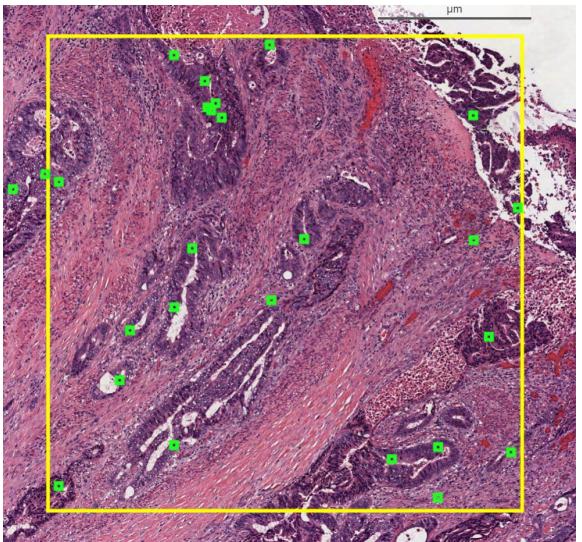


Multiple (Polygons, Ellipsis, Rectangles, Lines)

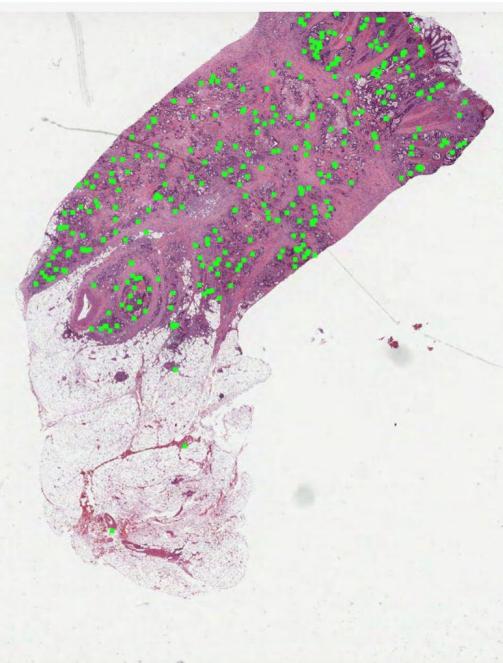
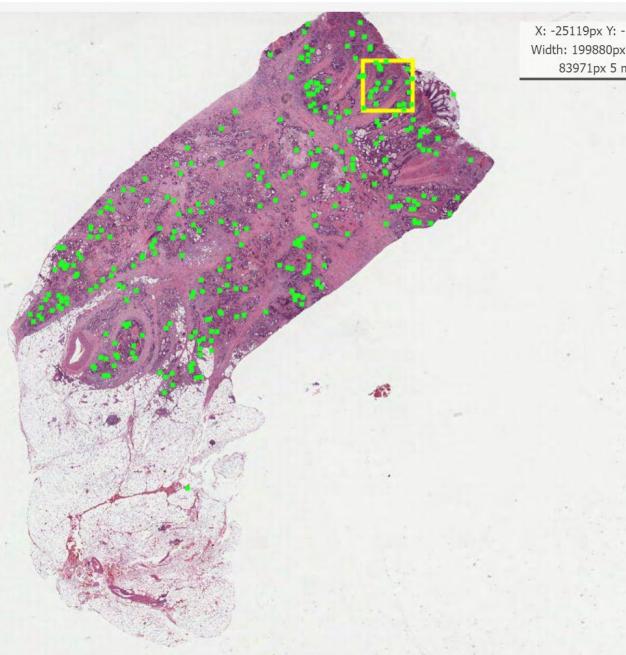
Examples of Annotations



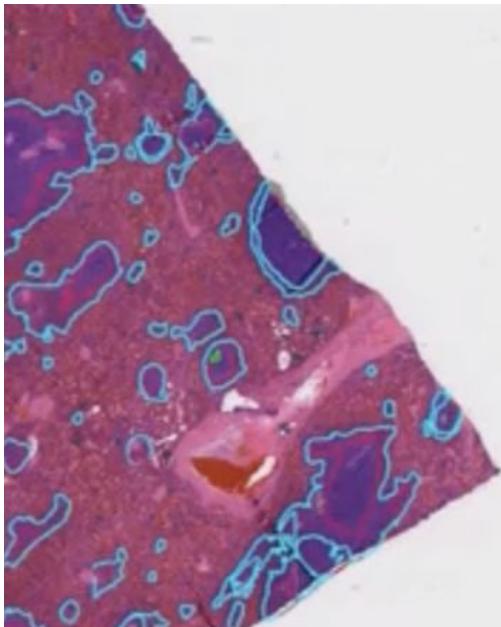
Examples of Annotations



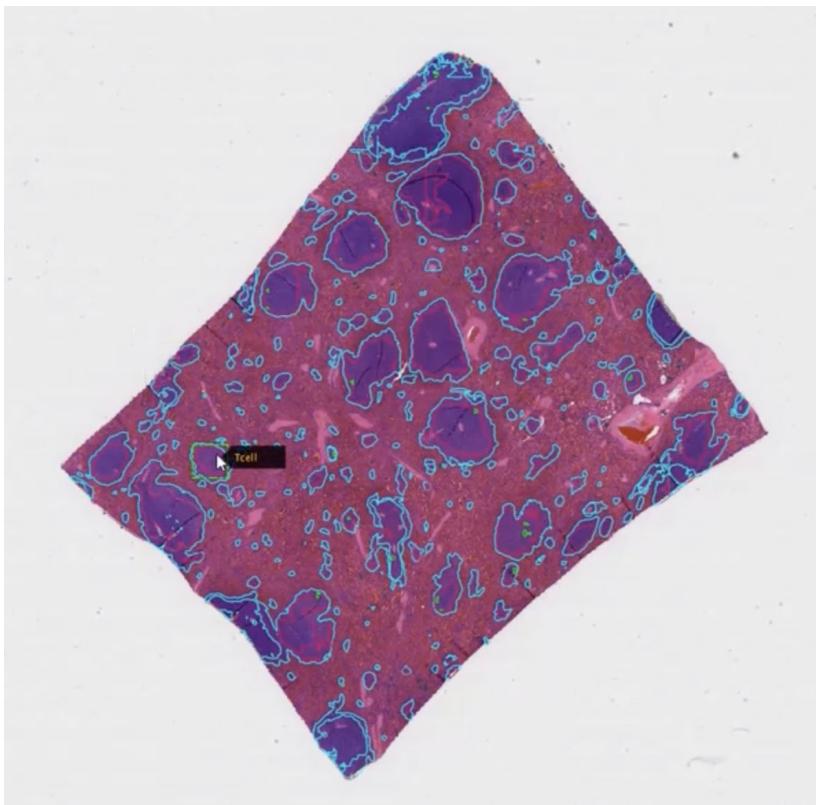
Polygons (N=641)



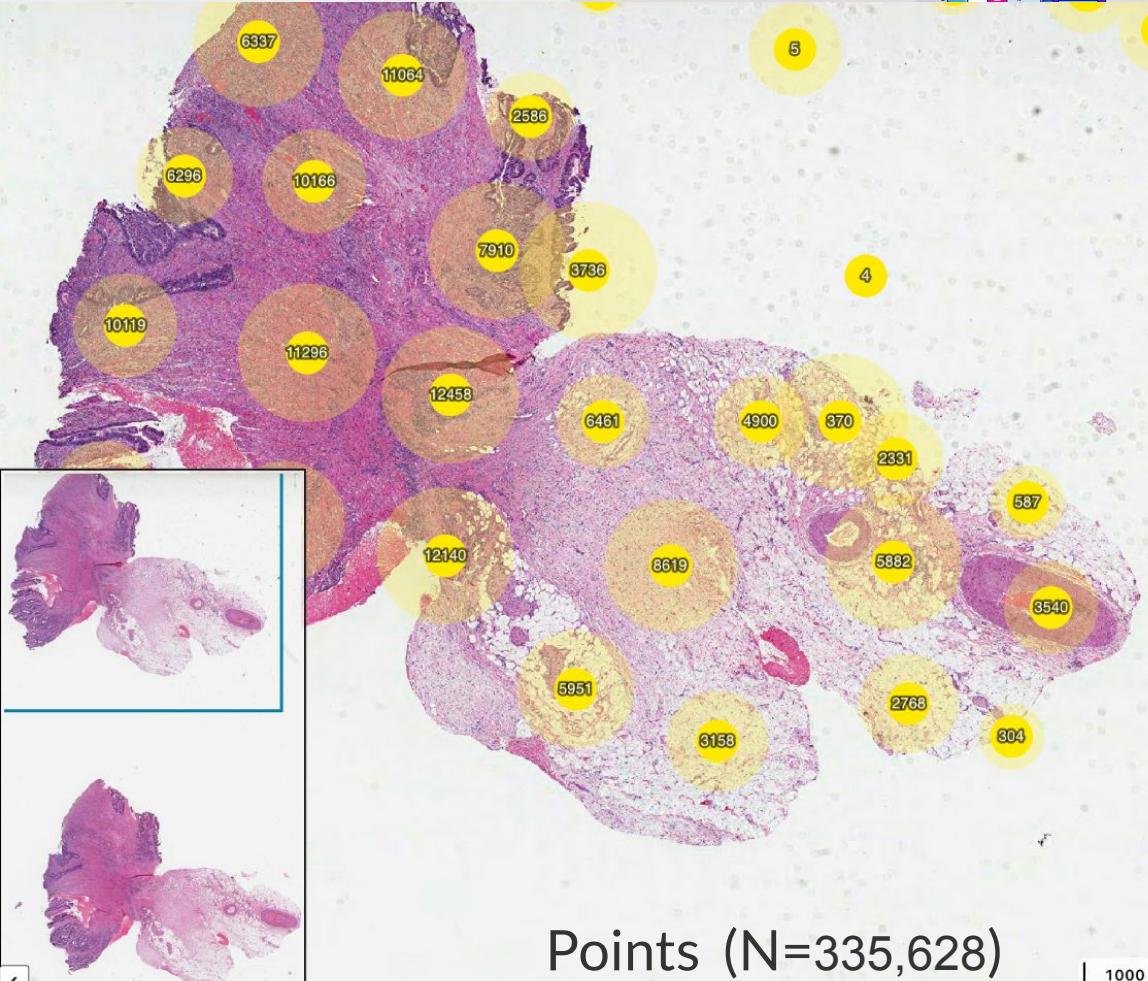
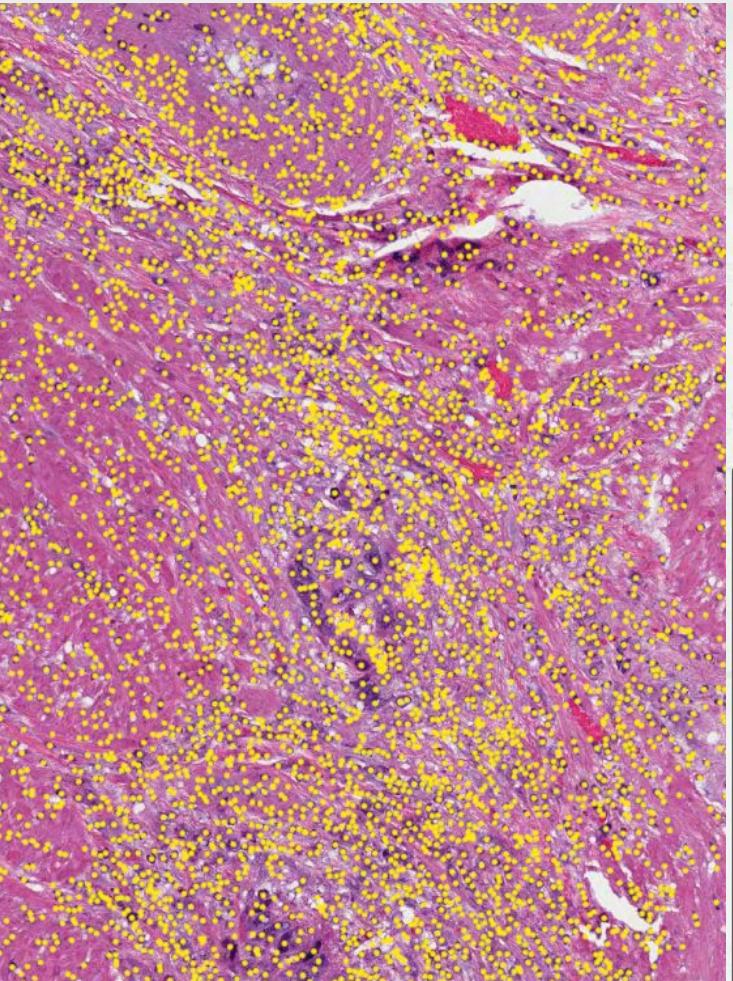
Examples of Annotations



Polygons (N=1,044)



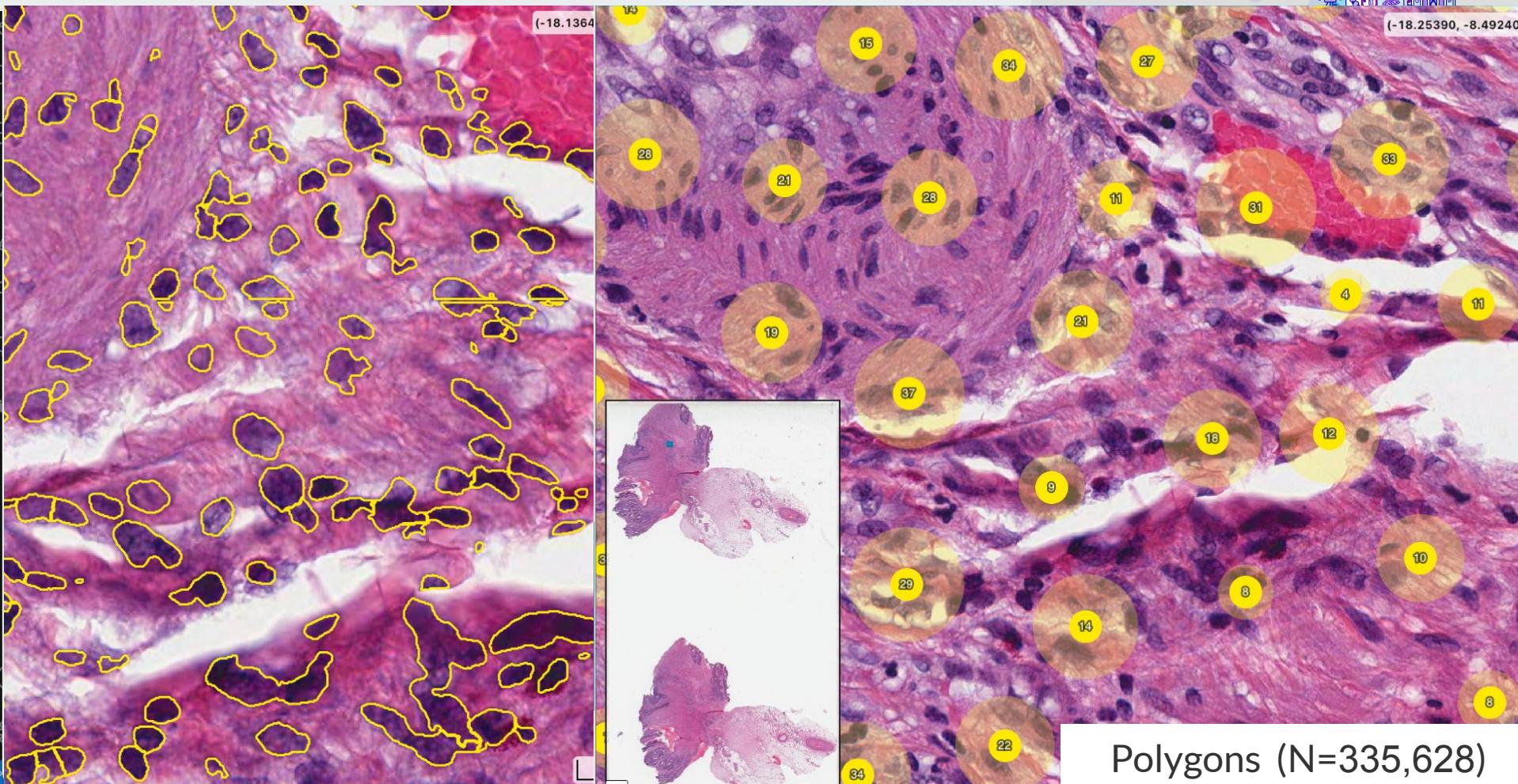
Large Annotations



Points (N=335,628)

1000 μm

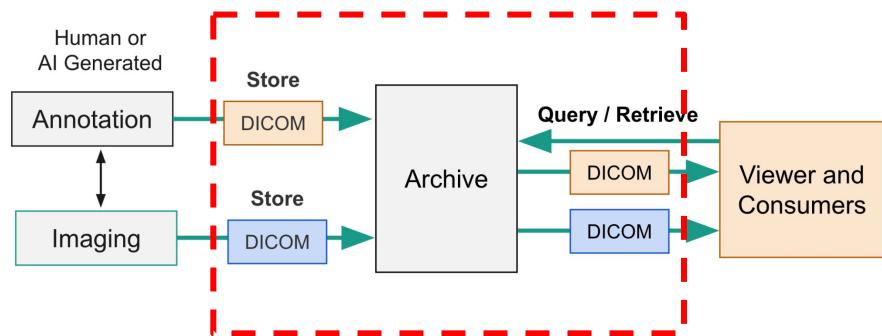
Large Annotations



Archives

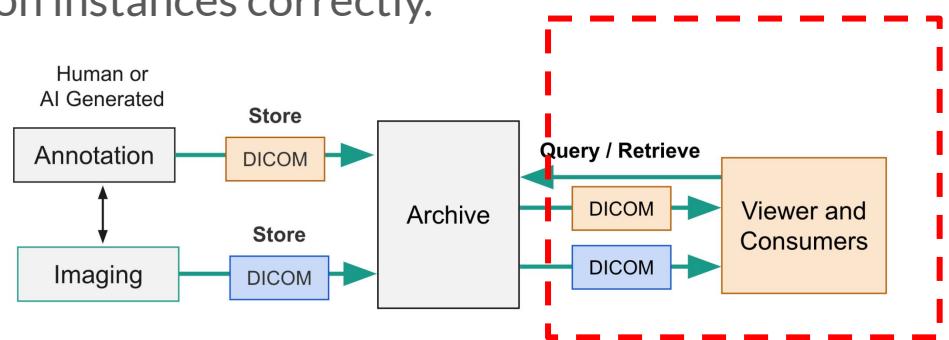
- Archives served WSI imaging and annotations without issue.
- Archives served viewer QIDO-RS and WADO-RS requests.
- **No issues reported by viewers:**
 - Retrieving list of imaging (studies)
 - Retrieving frame imaging
 - Retrieving annotations.

Interoperability demonstrated for annotation storage and retrieval.



Viewers / Consumers

- 2 of 7 viewers rendered all 20 annotations correctly.
- The consumer generated summary statistics for all annotations.
- 1 viewer rendered 19 of 20 annotations correctly
(Error due to conformance issue with source imaging).
- 4 viewers rendered (7 - 18) annotation instances correctly.



What can be improved:

- Add mechanisms to DICOM standard to:
 - Enable annotations falling within viewport to be quickly identified and retrieved.
 - Provide guidance / recommendation for how to render downsampled representations of an annotation.

Take away messages:

- Highly successful connectathon
- Diverse set of annotations tested which represent a range of annotation use cases (Human to ML generated).
- DICOM standard supports storage retrieval of whole slide annotations.

Action Items:

- Interoperability only works when vendors support it.
- When choosing annotation software, **require support for DICOM**.

Questions?

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