**DICOM and FHIR Track**

- **Short Description**
  
  DICOM/DICOMweb™ is used for Imaging-centric workflows. e.g. PACS, Post-processing applications.

  FHIR is used for information centric workflows. e.g. EMRs, EHRs.

  DICOM and FHIR Connectathon track is about integrating FHIR with medical imaging and DICOMweb™. In this track, the focus will be on contributing towards mapping of DICOM SR to FHIR and DICOM image sharing in ABDM context.

- **Long Description**
  
  The goals of the Connectathon are:
  
  1. Integrating FHIR® with medical imaging and DICOMweb™
  2. Extract key content from DICOM SR (AI Result, measurement report, etc) into FHIR resources, Observation
  3. Review and contribute to Mapping of DICOM SR to FHIR IG proposal
  4. Generate DICOM SR to FHIR mapping using TID 1500 as described in IHE AIR
  5. Demonstrate an integrated workflow of storing DICOM SR based AI results into FHIR Server and display in a FHIR based client application.
  6. Proposal for DICOM image sharing using ABDM in India context.

- **Type**
  
  Test and Implementation Guide

- **Submitting Work Group/Project/Accelerator/Affiliate/Implementer Group**
  
  Track Lead(s)

  Anand Jahagirdar

  Arunachalam Annamalai and Muralidhar Chowdary, N

- **Related Tracks**

  FHIR Starter Track

  FHIR Server Implementation Track

  ABDM Implementation Track

- **FHIR Version**

  FHIR R4

- **Reference**

  - DICOM SR Measurement Report Implementation Guide
    https://confluence.hl7.org/display/IMIN/Mapping+of+DICOM+SR+to+FHIR
  - DICOM SR to FHIR Observation Mapping IG Proposal
    http://dicom.nema.org/medical/dicom/current/output/chtml/part16/chapter_A.html#sect_TID_1500
  - IHE RAD Suppl AIR PDF
    https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_Suppl_AIR.pdf
Connectathon Orientation call

Friday, Nov 20th @ 1730 IST

Slidedeck:
https://fhirindia.zulipchat.com/user_uploads/32116/Xa_ijC_uARZL3bHKEvGhRsfI/DICOM_Basics_Training_Track_Connectathon_2021-2.pptx

Preconnectathon sessions / webinars:

<table>
<thead>
<tr>
<th>Sno</th>
<th>Session</th>
<th>Date and Time</th>
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<tbody>
<tr>
<td>1</td>
<td>DICOM and FHIR - Track orientation session</td>
<td>19th Nov, Friday, 530 PM</td>
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<tr>
<td>2</td>
<td>Overview of DICOM and DICOM Tools</td>
<td>20th Nov, Saturday 11AM</td>
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<td>3</td>
<td>Hands-on training on Orthanc DICOM Server and DICOMWeb interfaces</td>
<td>26th Nov, Friday 530 PM</td>
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<td>4</td>
<td>Insights of DICOM SR TID 1500 and IHE AIR profile</td>
<td>27th Nov, Saturday 11AM</td>
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<td>5</td>
<td>Walkthrough of DICOM SR to FHIR IG proposal</td>
<td>3rd Dec, Friday 530 PM</td>
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<td>6</td>
<td>Hands-on training on Scriban templating language</td>
<td>4th Dec, Saturday 11AM</td>
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Expected participants

Approximately ~20

Roles: like Architects, Product Managers / Product Owner , Developers , Testers, Research Scientist, Interoperability SMEs

Companies: Siemens Healthineers , forgeahead, Philips, Medsynaptic Pvt Ltd, XYRAM, CitiusTech

Zulip stream

https://fhirindia.zulipchat.com/#narrow/stream/272723-Training-.26.20Conferences/topic/DICOM.20and.20FHIR.20Track.20-.20FHIR.20Connectathon.20India.202021

Track Details

- Systems and Software
  - Acquisition system: Use DICOM for communication with other systems like PACS
  - AI based Imaging analysis software:
    - Capture measurements, derived measurements and qualitative evaluations in a DICOM structured report(SR) format.
    - In this Connectathon, TID 1500 based DICOM SR format will be used.
    - Radiologist will review content provided in the SR and may include the results in the report as observations.
  - Use case : Imaging measurements transformed to FHIR observations
    - Measurements are made from the acquired images.
    - Imaging analysis systems ( AI Machines) use TID 1500 and map the imaging measurements in the DICOM structured report.
    - Mapping from each measurement from the SR to an individual FHIR observation.
  - Use case : Image distribution in ABDM system ( analysis in progress)

Integrating AI workflow in Connectathon:

Pneumothorax is an example of how AI is used in a clinical environment for a potentially life-threatening but readily treated emergency
A patient presents in an emergency room after a motor vehicle accident and has an x-ray.

The image is obtained from the modality.

The images are sent to the PACS and AI algorithm.

Before a Radiologist sees the results, an AI algorithm detects and estimates pneumothorax size. The AI algorithm sends the report to the PACS as a DICOM SR with the information, identification, and graphic highlighting the pneumothorax.

The AI findings, while captured as DICOM SR for the Radiologist read, the AI Findings need to be encoded as a FHIR observation to interact with systems that are non-imaging.

“DICOM to FHIR Converter” component to be developed will:

- Fetch DICOM images and SR from PACS using DICOMWeb interface
- Parses the DICOM Study to generate FHIR ImagingStudy resource
- Parses the DICOM SR, applies mapping to create FHIR Observation resource.

The FHIR resources (ImagingStudy, Observation) will be sent to FHIR server for storing.

Referring physician reads patient clinical data along with data converted from DICOM for further patient care process.

Connectathon work

- PreConnectathon
  - Sessions/Webinars on DICOM, DICOMWeb communication, FHIR Observation resources
  - Understand TID 1500, IHE AIR to map the DICOM SR to FHIR
  - Hands-on trainings on tools required for the workflow integration:
    - Orthanc DICOM server, Dcmtk tools, AX DICOM tools, Liquid templating language

- Connectathon Output
  1. Report for review and improvement done for the DICOM SR to FHIR IG proposal
  2. Liquid template for DICOM SR to FHIR (based on TID 1500) mapping stored in Github
  3. End2End integration using several opensource tools to demonstrate the integrated AI workflow
  4. Recommendation to ABDM on the image sharing workflow - concept proposal
1. Connectathon participant to use DICOMWeb interfaces or StoreSCU to store prepared DICOM images and SR to Orthanc Server.
2. Use postman to query Orthanc server and store the DICOM image/SR JSON result on local system.
3. Generate Scriban template for mapping DICOM SR to FHIR using DICOM TID 1500 as defined in IHE AIR JSON to FHIR Observation and Imaging Study by applying the Scriban templates generated.
4. Use online scriban converter tool (https://scribanonline.azurewebsites.net/) to convert DICOM SR/Image JSON to FHIR Observation and Imaging Study by applying the Scriban templates generated.
5. Use postman to post the FHIR generated resources (Observation, ImagingStudy) to FHIR server.
6. View the results using postman by connecting to FHIR Server.

Tools/Opensource to be used during connectathon

- Dcmtk
- AX DICOM Tools
- Fo-Dicom library
- Orthanc DICOM Server
- Hapi FHIR Server
- Scriban templating language

Schedule for Connectathon
<table>
<thead>
<tr>
<th>Day</th>
<th>Time</th>
<th>Activities</th>
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<tbody>
<tr>
<td><strong>Friday, December 10, 2021</strong></td>
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<tr>
<td></td>
<td>3:00 PM - 4:30 PM</td>
<td>90 Mins Inaugural activities</td>
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<td>5:00 PM - 7:00 PM</td>
<td>120 Mins Overview of (IHE AIR, DICOM TID 1500, DICOMWeb Interfaces, AI Workflow, Scriban templates)</td>
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<td>8:00 AM - 9:00 AM</td>
<td>60 Mins Hands-on DICOMWeb Interfaces</td>
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<td>9:00 AM - 10:00 AM</td>
<td>60 Mins Expert Session by Lloyd McKenzie and Graham Brieve</td>
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<td>10:20 AM - 01:00 PM</td>
<td>160 Mins DICOM Study - FHIR ImagingStudy Mapping overview (30 mins) breakout (100 mins) summary (30 mins)</td>
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<td>Lunch Break (60 Mins)</td>
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<td>2:00 PM - 5:00 PM</td>
<td>180 Mins DICOM SR - FHIR Observation Mapping Creating Liquid(Scriban) templates for TID 1500 Imaging Measurements - CT SR</td>
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<td>Break (20 Mins)</td>
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<tr>
<td></td>
<td>2:00 PM - 5:00 PM</td>
<td>100 Mins DICOM SR - FHIR Observation Mapping Creating Liquid(Scriban) templates for TID 1500 Imaging Measurements - MR SR</td>
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<td>7:00 PM onwards</td>
<td>100 Mins C# / JS Code to integrate AI workflow components</td>
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<td><strong>Saturday, December 11, 2021</strong></td>
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<tr>
<td><strong>Sunday, December 12, 2021</strong></td>
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<tr>
<td></td>
<td>08:00 AM - 09:30 AM</td>
<td>120 Mins Discussion: Imaging integration in ABDM</td>
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<td>09:30 AM - 10:30 AM</td>
<td>30 Mins Open forum, Q&amp;A, Wrap up</td>
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<td>Break (15 Mins)</td>
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<td>10:45 AM Onwards</td>
<td>Common Closing ceremony</td>
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