IHE Process

1. **Define** a clinical use case involving connectivity.
2. **Create** Integration Profiles to specify how existing data standards are to be used to solve clinical problems.
3. **Test** the adherence of clinical systems to Profile specifications.
4. **Publish** results to assist users in selecting interoperable systems.

IHE Testing

IHE Testing is based on specifications laid out in the Technical Framework. Vendors register to test products as one or more Actor(s) within an Integration Profile. Adherence is tested by demonstrating:

1. Behavior (input, output, display) conforms to requirements for each “Transaction”.
2. Successful exchange of clinical information with other vendors’ products playing the role of other Actor(s) in the Profile.
What is a Connectathon?

Cross-vendor, live, supervised, structured test event

- All participating vendors’ products tested together in the same place/time.
- Experts from each vendor available for immediate problem resolution... fixes are often done in minutes, not months!!
- Each vendor tests with multiple trading partners (actual product to product).
- Testing of real-world clinical scenarios with IHE Integration Profiles.
- Supervised by test monitors, i.e. “judges”.

Connectathons

- IHE NA Connectathon (annual since 1999)
  - Radiology and 9 other domains
  - >100 vendors, >550 engineers
  - Cleveland Convention Center
  - January 23-27, 2017

- IHE-RO Connectathon (since 2007)
  - Radiation Oncology Domain
  - 5-8 vendors
  - Philips, Madison, WI
  - October 17-21, 2016

IHE-RO Connectathon

- Annual, week-long event
  - ½ day setup
  - ½ day cleanup
- Hosted at ASTRO HQ, vendor facilities, and academic centers
- Supervised, informal test events (“Domain Pre-Testing”) have also been held between connectathons.
IHE-RO Connectathon Venues

<table>
<thead>
<tr>
<th>Year</th>
<th>Connectathon</th>
<th>Domain Pre-Testing</th>
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</thead>
<tbody>
<tr>
<td>2006</td>
<td>ASTRO, Fairfax, VA</td>
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<tr>
<td>2007</td>
<td>ASTRO HQ, Fairfax, VA</td>
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<tr>
<td>2008</td>
<td>MD Anderson, Houston, TX</td>
<td>Brainlab, Munich, Germany</td>
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<td>2009</td>
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<td>Siemens, Erlangen, Germany</td>
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<td>2010</td>
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<td>Fundacion Iavante, Granada, Spain</td>
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<td>2011</td>
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<td>Elekta, Stockholm, Sweden</td>
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<td>2012</td>
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<td>Washington Univ., St. Louis, MO</td>
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<tr>
<td>2013</td>
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<td>Brainlab, Munich, Germany</td>
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<td>2014</td>
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<td>Varian, Zug, Switzerland *</td>
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<td>2015</td>
<td>Sun Nuclear, Melbourne, FL</td>
<td>Raysearch, Stockholm, Sweden *</td>
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<tr>
<td>2016</td>
<td>Philips, Madison, WI</td>
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* Included formal testing

IHE-RO Test Process

- IHE-RO judges select test cases and provide instructions for participants to interact with multiple test partners.
- Adherence to a profile is demonstrated for each Actor by successful transactions with:
  - 3+ upstream Actors
  - 3+ downstream Actors

Connectathon Judges

- Volunteers (clinical physicists and physicians) who assist in testing adherence of products to IHE-RO Profiles.
- Assist vendors in creating meaningful test data.
  - The purpose of testing is NOT to see which product is "best".
  - Want test data and plans to be as clinically relevant as practical.
- Compare data displayed by "producer" and "consumer" Actors
  - Side-by-side comparison of product displays.
  - Assure consistent interpretation of information in both products.
Test Archive

- A DICOM ARCHIVE is used to store:
  - Initial test datasets
  - Output data from "Producer" Actors
  - Input data for "Consumer" Actors
- Initial test dataset:
  - Starting data for the first Actor in a Profile
  - Stored in the Archive before testing begins
  - Each vendor starts with their own test dataset instance (Patient ID with vendor code)
- Data produced by Profile Actors can be retrieved for troubleshooting and analysis by judges.
- The Archive is supplied and operated by a vendor volunteer.

Advanced RT Integration Profile

- Exchange of treatment plan content (DICOM RT Plan)
  - **Producer** (TPS)
  - **Consumer** (TPS/TMS)
- Constraints on plan content are specified for each of 14 beam techniques:
  - Basic Static Beam
  - Static MLC Beam
  - Arc Beam
  - MLC Arc Beam
  - Conformal Arc Beam
  - Hard Wedge Beam
  - Motorized Wedge Beam
  - Virtual Wedge Beam
  - Static Electron Beam
  - Step & Shoot Beam
  - Sliding Window Beam
  - IMAT/VMAT Beam
  - Stereotactic Beam
  - Stereotactic Arc Beam

Advanced RT Integration Profile Constraints
Advanced RT Integration Profile
Test Procedure

- Test datasets are created for each vendor and stored in an Archive (CT images and RT Structure Set).
- Plan producers retrieve test datasets and create and store RT Plans for each beam technique per planning instructions.
- Plan consumers retrieve producers’ plans from the archive and display them.
- Judges compare side-by-side plan displays on producer and consumer systems to check consistency.
- Goal: demonstrate successful exchange with 3+ partners

Advanced RT Interoperability Profile
Test Instructions

- Instructions for testing ARTI Plan Producer Actors
- Also includes a table of detailed plan parameters to be used.

Connectathon Scoring

- ARTI checklist of plan parameters used for side-by-side comparison of Producer and Consumer Actors
IHE-RO Integration Profiles in Testing

- Basic RT Objects Profile (BRTO)
- Advanced RT Integration Profile (ARTI)
- Multi-Modality Image Registration for Radiation Oncology (MMRO-II)
- Dose Compositing Profile (DCOM)
- Treatment Delivery Workflow-II (TDW-II)

IHE-RO Test Tools

- Test Tool software is used to
  - Assist manufacturers with in-house software testing,
  - Assess readiness of products to participate in formal testing at Connectathons,
  - Assist testers in the formal testing process.
- Connectathon participants must demonstrate that their products pass Test Tool validation by submitting Test Tool results to judges.

- IHE-RO Test Tools are developed and maintained by ICT Automatisering, using the open-source DICOM Validation Toolkit (DVTk).

IHE-RO Test Tool Operation

- Test Tool software
  - Simulates the behavior of other Actors in a Profile as a surrogate test partner,
  - Provides reference input data to the Actor under test,
  - Validates the content of data objects produced by the Actor.
Connectathon Test Results

- Connectathon successes are published.
- Incomplete test(s) or failures are NOT published.
- Vendors release Integration Statements for "IHE-RO Compliant" products to indicate the specific Profile(s) and Actor(s) for which the product has been successfully tested.
- Integration Statements for products that have passed the IHE-RO testing process can be found on the ASTRO website (search "IHE-RO testing")
- Systems tested at a Connectathon must match those referenced in the manufacturer’s Integration Statement. Re-testing is needed if some part of the product that affects interoperability is changed.

Thank You