IHE-RO Technical Committee
Domain Testing Report
March 3-6, 2008
BrainLAB HQ, Munich, Germany

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Monday

- We have a group of 22 individuals here, representing Tomotherapy (4), Philips, CMS (2), Nucletron (2), Siemens (4), Varian (2), BrainLab (3), Elekta/IMPAC (2), and clinical people from the SEFM and ASTRO (2).
- BrainLab has done a great job on setting up for us. When we arrived this morning, network, power cords, ID badges, and key/food cards were ready and waiting. We have a great room just off the main entrance and looking out on an internal central courtyard. Customer demonstration rooms and the lunchroom also surround the courtyard. Many thanks to Christof Schadt and Uli Beifuss, as well as others at BrainLAB for the facilities.
- We only had one major set of sparks (230V power), courtesy of IMPAC. Fortunately, it did not affect a critical system and everything is up and running. Christof has setup a WIKI for the testing session, allowing manufacturers to update their data as they configure their systems.
- Today was dedicated to setting up equipment, testing network connections, and getting systems configured for testing. Test data sets from several vendors have been loaded onto the archive server in preparation for the more formal sessions.
- There are 6 vendors planning to test the registration profile; Phiips, CMS, Nucletron, Siemens, Varian, and BrainLab. Testing against the Worklist profile are Elekta, Siemens, Tomotherapy, and Varian. IMPAC is providing archive support for both profiles.

Tuesday

- Manufacturers continue to debug and test their implementations of the 2008 profiles. There are several DICOM Objects that are new to the Radiation Oncology domain. These include:
    - Spatial Registration Objects
    - RT Beams Delivery Instruction
    - Treatment Workflow Unified Procedure Step instructions
- As part of the preparation for the Domain Testing sessions, BrainLAB created a WIKI for storing the information on IP and AET addresses for each manufacturer, attendees, and general network configuration. This information will be bundled up so that future testing sessions can continue to update.
- There was a discussion this afternoon on a number of issues (both mundane and critical).
    - It was confirmed that TMS actors shall supply a Study Instance UID to Treatment Delivery Devices
    - There was a long discussion on how the profiles need to be tested. Details are below. This will be further discussed later in the week.

- In discussions on the Worklist profile, it was noted that Treatment Plans are not required to be supplied by the TMS. In some cases, the Treatment Delivery Devices will have plans stored in their own databases and only need the UID of the specific plan to be delivered (so that the correct plan can be pulled from the database). This allows treatment devices that use plans not currently supported by DICOM to be a part of the worklist profile.
- Currently, no manufacturers have indicated that they intend to support a Patient Positioning System (PPS) for the 2008 Connectathon, either stand-alone or integrated into a Treatment Delivery Device (TPD). There are Treatment Delivery Device (TDD) and Treatment Management System (TMS) manufacturers that have indicated a desire to participate if they are ready and the profile chosen to be tested.
- There was a long discussion on how the registration profile should be tested. Some members of the Technical Committee would like to see quantitative testing of the spatial registrations,, e.g. do the registrations safely and accurately determine the correct transformation. Others felt that this type of testing was generally out-of-band for IHE. However, testing to be sure that the spatial registration was correctly received and applied by devices such as the Registered Contourer, Registered Display and Registered Dose Display is in-band and all agreed that this must be done.
- The TC will meet one day of Saturday / Sunday. BrainLAB offered to bring lunchroom staff in for that day, but the attendees all agreed that was not necessary. We will either order food in (pizzas, subs) or take an extended lunch in order to allow individuals to get lunch on the day selected.
- A list of additional agenda items for the TC meeting has been building. This are in addition to the two primary tasks already scheduled for the TC. The current list of agenda items is as follows:
    - Development of an Extension to the 2007 profile for more complete RT Plan support as a 2009 demonstration
    - Decision on the viability of a 2008 Connectathon for the new Spatial Registration and Worklist Profiles
    - Implications of IHE-Oncology on IHE-Radiation Oncology for vendors
    - Assessment of Supplement 74 by Radiation Oncology Vendors and how can external verification be accomplished (request from WG6)
    - How will Gazelle development (IHE Testing and Tools new Test Tool Platform) affect IHE-RO
    - The role and scope of emulators in Worklist testing, Connectathon, and Public Demonstration
    - How does IHE-RO manage testing of existing profiles for new vendors / new products
    - The progress of the 2008 IHE-RO Test Tools
    - In the Registration Profile, what is the meaning of the Reference Image Sequence in the Spatial Registration Object.

Wednesday

Spatial Registration Profile Discussion

- There was a discussion on the sequence of transforms that exists in the Spatial Registration Object. At present it is required that there be one transform for each sequence item in the Registration Sequence. For the primary image dataset, the transformation matrix shall always be identity. Although somewhat superfluous, having this identity matrix allows conformance with recommendations put forth in other usages of the Spatial Registration Object outside Radiation Oncology. The group agreed that this was useful and recommends no changes in this interpretation.
- A discussion was also held on the limitation in the profile to solely one pair of transformations (e.g. a primary and a single secondary image dataset/frame-of-

reference) in the Spatial Registration Object. While this could be relaxed in future profiles, it is also consistent with some out-of-band implementations that use Blended Presentation state. The group agreed that this was useful and recommends no changes in this interpretation.

- Common Instance Reference Module - This is currently a mandatory module which includes the Series and Instance Reference Macro. This macro includes a required sequence of references to other instances that reference this object. However, there can be cases where no other references exist. (This problem is currently under review elsewhere and the sequence will likely be changed to 1C.) However, until that time, it was agreed to recommend that no mention of this sequence be made in the profile, and no semantics be associated with the sequence for purposes of the profile. Thus, no change in the current profile as written.

General Report

- Progress continues to be made on testing of the Spatial Registration and Worklist Scheduling implementations. An informal round of test review will be done on Thursday, as several of the manufacturers have indicated that their implementations are sufficiently debugged for review.
- In general, a large number of bug fixes have been made over the past three days in inter-manufacturer testing. In addition, several manufacturers have brought initial simulation products that are being used to validate communication protocols for products to be developed. This is true in both spatial registration and in worklist scheduling. Most of the work accomplished in the spatial registration profile centered around consistent interpretation of the Spatial Registration Object. This appears to have reached a general consensus, as a number of test datasets appear to be handled correctly across multiple vendors.
- In Thursday's test review, all previous spatial registrations will be removed from the archive server, leaving only the test image datasets. Manufacturers will then show that they can create the Spatial Registration Object and then send it correctly to several display actors.
- Similarly, progress has been made on RT Worklist integration. It is expected that Siemens and Tomotherapy machine emulators will be tested by retrieving plan information from two TMS's, performing the treatment, and then reporting back the conditions of the treatment using the RT Worklist profile.

Thursday

RT Worklist Profile Discussion

- David reviewed some changes in the profile documentation. A major change was in the optionality of the retrieval of input objects from archive (RO-15). According to the table, it was required. However, the profile allows treatment delivery devices to have those objects separately managed, therefore this is optional. The rationale for this option is that there are devices, such as Tomotherapy, that have unique and generally unsupported treatment plans that it solely generates. For other devices, including independent patient positioning systems, there is a question on whether the profile requires those devices to be able to retrieve those objects as needed. We do not want devices to require objects, but have no means of retrieving them within the profile, if they do not support the ability to acquire such information.

  There was no easy consensus on these changes. It was decided to move this discussion to the formal IHE-RO Technical Committee meeting, which starts Friday.
- Testing was started on the Spatial Registration Profile
    - Brainlab

        - Registrator
        - Registered Display
    - Varian
        - Registrator
        - Registered Display
    - Siemens
        - Registrator
        - Registered Display
    - Nucletron
        - Registered Display
    - CMS
        -
    - Philips
        - Registrator
        - Registered Display
- Testing was also done on the RT Worklist Profile
    - Tomotherapy
        - Treatment Delivery Device
    - Siemens
        - Treatment Delivery Device
    - Elekta
        - Treatment Delivery Device
    - Varian
        - Treatment Management System
    - IMPAC
        - Treatment Management System
- Some testing issues that were noted:
    - Keeping track of different Spatial Reg Objects (which manu, which case, ...)
    - Sign of the transform: A known transform of 5 degrees was shown as +5 and -5 by different vendors. This appears to be a left-handed / right-handed coordinate system issue.
        - Need to have specific and well-defined angle for testing.
    - Image datasets having different study IDs. This should be OK, some manufacturers had problems with it.
    - Some manufacturers were not sending the Common Instance Module, which is at present required, though there is generally no useful data in it.
    - Some manufacturers were not sending the identity matrix for the initial (primary) image dataset/FoR. This is not in line with the profile conformance.
    - There should be a test data set with valid registration that can be used to test Registered Displays first. These cases should have known registrations that include rotations and transformations in all 6 degrees of freedom. Once RDs have passed this test, they can be used to validate the Registrators.
    - For Workflow testing, tests should include (a) Standard Treatment Delivery, (b) Treatment Delivery w/interrupted completion, and (c) Treatment Delivery w/delayed completion requiring a later completion treatment. One needs to observe the information on both the TMS and TDD, noting the interaction to find a scheduled patient, get all information needed for treatment delivery, and interruption / completion interactions.