PROGRAM

2005 INTERNATIONAL CONFERENCE & SEMINAR

September 26 – 28, 2005

Hilton WestEnd Hotel
Budapest, Hungary

DICOM 2005 International Conference
Budapest, Hungary
SEMINAR
Monday, September 26, 2005

[8:00 – 8:45] Registration

[8:45 – 9:00] B01: Welcome and Kick Off – 15 min
Prof. Attila Naszlady, M.D.; [Budai Irgalmasrendi Hospital]

Attila Naszlady (born on 04. Nov. 1931. Budapest, Hungary); M.D. graduated in Semmelweis University, Budapest, Hungary, 1958; Research Fellow of World Health Organization in Göteborg(Sweden), Naples, Milano(Italy) Academic D.Sc., in 1979; Professor h.c. in 1980; IMEKO member of TC-13, as representative for Hungary from 1985-1997 Academician in Pontificia Accademia Tiberina, Rome, Vatican 1999; specialist in internal medicine 1965, European Cardiologist 2000; Med. Dir. of Hungarian Maltese Charity Service 1996- ; Expert in informatics 1989. Representing member for Hungary of EU DGXIII CEN/TC251; President of the European Federation of Med. Inform. (1998-2000); Gen. Med. Di.r. of Policlinic of Hospitaller Bros. of St. John of God in Budpest 2000-

Scientific work: interactions between structure and function in the cardio-pulmonary system – experimental, clinical and 3-D computer modelling; results published in more than 120 sci. articles, in book chapters and invited lectures on Internatl. Congresses in Warsaw, Copenhagen, London, Bermuda etc..

Awards: Knighted in O.E.S.S.H. in Castle of Bouillon, (Belgium) 1993; Denis Gabor award for innovation1998; Golden Cross Medal of Merit from Sovereigne Maltese Knight Order 1999;

Teaching activities: Clinical Physiology in Med. University, Cardiology in Postgraduate Med. School and Bioengineering in Technical University, Budapest, Hungary.-

Innovations, patents:
- 1963 Capillar-microscope,1964 balloon for reanimation, 1964 extracorporal cardiac pacemaker
- 1966 lab. fraction collector, 1984 SANINFORM memory chip system(OTH Pat.reg No190572),
- 1995 Patient documentation on chip card,
- 1997 Chip-doki software

[9:00 – 12:30 & 16:35 – 17:30] DICOM - As It Works Today Session – 3.9 hrs
Chair: Dr. Peter Mildenberger, Co-Chair DICOM Stds. Cmte [German Roentgen Association]

[9:00 – 9:30] B11: Basic DICOM Concepts with Healthcare Workflow – 30 min
Dwight Simon, Co-Chair DICOM Stds. Committee [Merge Healthcare]

DICOM Terminology (Services Classes and SOP Classes)
DICOM Functions (Storage, Query/Retrieve, Print, Media)
DICOM Conformance Statement
Where and How DICOM, HL7 and IHE fit into the overall Healthcare Workflow

[9:30 – 9:55] B12: Exchanging Imaging Data – 25 min
Harry Solomon [GE Healthcare]

Various Modality Images, Presentation States, Structured Reports
Finding and Retrieving Imaging Objects

[9:55 – 10:20] B13: Managing Acquisition Workflow – 25 min
Kevin O'Donnell [Toshiba America, MRI]
- Modality Worklist
- Modality Performed Procedure Step
- Storage Commitment of Persistent Objects
- Instance Availability Notification

[10:20 – 10:50] Break – 30 min

[10:50 – 11:15] B14: Consistent Presentation of Images – 25 min
Geert Claeys [AGFA Healthcare]
- Grayscale Standard Display Function
- Grayscale Softcopy Presentation State
- Print Presentation LUT

[11:15 – 11:50] B15: Application of DICOM Structured Report – 35 min
Andrei Leontiev [Dynamic Imaging]
- Key Object Selection
- Specialized Structured Reports

[11:50 – 12:10] B16: Post-Processing and Reporting Workflow – 20 min
Cor Loef [Philips Medical Systems]
- General Purpose Worklist

[12:10 – 12:30] B17: Basic Security – 20 min
Lawrence Tarbox, Ph.D. [Mallinckrodt Institute of Radiology]
- DICOM over TLS
- Media Security
- Confidentiality Profile

[12:30 – 13:30] Lunch – 1 hr

[13:30 – 16:35] Real Use of DICOM in the Domains Session – 3 hours
Chair: Dwight Simon, Co-Chair of DICOM Stds. Committee [Merge Healthcare]

[13:30 – 14:00] B20: Radiology, Nuclear Medicine, Mammography & CAD – 30 min
Dr. Peter Mildenberger, Co-Chair of DICOM Stds. Committee [German Roentgen Association]

[14:00 – 14:30] B30: Radiation Therapy in Oncology – 30 min
Colin Winfield [Elekta Limited]

[14:30 – 15:00] B40: Pathology – 30 min
Dr. Bruce Beckwith [Beth Israel Deaconess Medical Center and Harvard University]

[15:00 – 15:20] Break 20 min

[15:20 – 15:35] B50: Cardiology – 15 min
Harry Solomon [GE Healthcare]

[15:35 – 16:05] B40: Ophthalmology – 30 min
Dr. Lloyd Hildebrand [American Academy of Ophthalmology, Univ. of Oklahoma HSC]

[16:05 – 16:35] B60: Dental – 30 min
Dr. Allan Farman [American Dental Assoc., Univ. of Louisville]

[16:35 – 17:30] DICOM - As It Works Today Session (Continued) – 55 min

Chair: Dr. Peter Mildenberger, Co-Chair DICOM Stds. Cmte [German Roentgen Association]

[16:35 – 17:00] B90: Deployment of DICOM Conformance Statement – 25 min
Don Van Syckle [DVS Consulting]

How widely deployed
Ease of Use vs. Earlier Version
    Integration Services (Vendors)
    Healthcare Facilitators (Users)
How to use (Hightlights)

[17:00 – 17:30] Panel Discussion Session – 30 min

- Our panel will answer any questions about DICOM, HL7, and IHE.
- They are willing to participate in any healthcare related workflow and integration discussions both now and during the social gathering afterwards.

Panel will consist of:

- Andrei Leontiev [Dynamic Imaging]
- Harry Solomon [GE Healthcare]
- Cor Loef [Philips Medical Systems]
- Don Van Syckle [DVS Consulting]
- Dwight Simon, Co-Chair DICOM Std Cmte [Merge Healthcare]
- Kevin O'Donnell [Toshiba America, MRI]
- Lawrence Tarbox [Mallinckrodt Institute of Radiology]
- GeertClaeys [AGFA Healthcare]

[18:00 – 20:00] Social Gathering

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SELECTED PAPERS

[8:00 – 10:05] Session 1: New Developments in DICOM – 2:05 hrs

[8:00 – 8:05] Welcome – 5 min
Bob Britain, Vice President, Medical Products, NEMA

[8:05 – 8:25] B101: New DICOM CT/ MR objects Will Enhance Clinical Radiology – 20 min
Reinhard Ruf [Siemens Medical Solutions]; Kees Verduin [Philips Medical Systems]

The recently standardized Enhanced CT and MR image objects overcome the current limitations of DICOM CT and MR, and enables new applications: improved compatibility, handling the organization of increasingly large datasets, new acquisition attributes, high performance through multiframe images, CT Angiography, CT Cardiology, MR Functional, MR Spectroscopy and much more. Especially image navigation, based on newly standardized attributes, will be one of the most predominant features.
During SCAR 2005, a Test and Demonstrations session took place, which was titled:

`Ready For The New CT & MRI DICOM Standard?` This multi-system, multi-modality, multi-vendor, connection-session was meant to:

- Show potential implementations and the compatibility in medical equipment,
- Provide radiologists, other users and administrators with an educational opportunity for planning the migration of their CT and MR radiology equipment in order to benefit from this extension to the standard.

It has shown the strengths of the new standard, but also different interpretations of the standard by vendors, which required urgent action.
This presentation will describe the *enhanced interoperability* for many clinical CT and MR applications in distributed networks once the new standard has been implemented in both the modalities and in clinical workstations.
We will summarize the results of the SCAR 2005 session and familiarize those that have not been involved so far with the future plans of the *Enhanced CT-MR Taskforce* for RSNA 2005.

[8:25 – 8:45] B102: Basic DICOM Enhanced XA Object – New Dimensions for Projection Imaging – 20 min
Heinz Blendinger [Siemens Medical Solutions]

Nearly as first addition to the initial release of the DICOM Standard in 1993, the XA Image Object definition was added in 1996 as Supplement 4. It is used merely unchanged until today, but a closer look reveals that new applications and techniques require more elaborate data definitions and encodings for already existing and emerging workflows. An ever increasing number of vendors' private attributes proves this demand.
In 2002, the "resting" DICOM WG-02 (Projection Radiography and Angiography) was revived and took the responsibility to address the needs identified to develop an Enhanced XA IOD based on the principles introduced with Enhanced CT and MR definitions. Today's possibilities will be expanded and the use of "per frame" encoding will be opened to such an extent that the new IOD can scale from simple C-arm equipment to complex Biplane systems in neuro-radiology using rotational angiography and 3D reconstruction.

The presentation will show the enhancements to support the workflow of today's applications. The usage of Functional Groups, Dimensions, Coordinate systems and other extensions will be outlined with practical examples to show the interoperability of new applications in projection imaging using Enhanced XA/XRF SOP Class.

[8:45 – 9:05] B103: Future Topics for Projection Imaging – Dose Reporting, Volume Objects – 20 min

Heinz Blendinger [Siemens Medical Solutions]

With MPPS the first facility to report dose-related accumulated values was introduced to the DICOM Standard. The MPPS is addressing RIS systems and can be used to display basic accumulations. The user community (esp. the physicists), however, have identified several shortcomings with such a solution. No real documentation about the physics of irradiation events applied to patients is possible; no further deduction on stochastic or deterministic risks is feasible. The rules applied to archival of images do not apply to the dose information in this context. Furthermore, the intended scope of such information for later use typically demands the usage of Structured Reporting mechanisms when looking for a solution.
New procedures in Neuro-Radiology or advanced Angiography will allow reconstruction of volumes derived from rotational angiograms. The current implementations choose CT slice image sets to store the results of such reconstruction algorithms. This does neither allow to preserve the real context of the acquisition, nor does it allow interoperability with complex 3D applications. Such data sets are by nature not slices but rather isotropic volumes. No Image Object (IOD) is currently defined in DICOM to allow encoding of such data. Additionally, the display of volumes cannot be seen as complete, unless 3D graphics can be stored separated from the pixel data. As of today, this requires additional definitions in the Standard.
Being named “Projection Radiography and Angiography”, the DICOM WG-02 has proposed a work-item to create one or more IODs to store 3D Volume data and related graphic presentation information. Supplementary, since the group typically deals with X-Ray related information, the chair has volunteered, with the support from the group, to edit the Dose Reporting Supplement 94. This presentation, at the date of issue, will give an overview on the use cases addressed by future DICOM Dose Reporting Standards. Furthermore, the data structure is outlined and how future applications may take advantage of it to present additional information to the medical user.
For the activity on XA 3D definitions, the requirements to be solved by this new volume object classes will be presented and, as far as possible, first solution tracks will be sketched out.

[9:05 – 9:25] B104: Experience of the New Ophthalmic Photography Image IODs in Application: Benefits and Disadvantages – 20 min

C.F. Nielsen, Ph.D.; S. Claesen, Ph.D. [ComMedica Limited]; R.I. Kitney, D.Sc. (Eng), Ph.D. [Dept of Bio engineering, Imperial College of Science]

The Photographic Visible Light and Secondary Capture IODs have until recently been the only viable choices for DICOM encoding of ophthalmic images, with storage of multi-frame images restricted to the Multiframe Secondary Capture IODs. The encoding of specialist ophthalmic acquisition parameters within a radiology framework was prohibitive and even encoding of imaging position presented a problem.
The new Ophthalmic Photography Image (OP) and Stereometric Relationship IODs provide dedicated modules for ophthalmic acquisition parameters and better support for stereo display parameters. With the inclusion of the Multi-frame and Cine modules, they cater for a combination of singe-frame and multi-frame acquisitions. However the multitude of new supported attributes and especially the new mandatory attributes require the implementer to make decisions about how this information can be collected in a way, which is both practical and does not cause unnecessary interruptions to the workflow of the user.

Using the ComMedica O-PACS product as a case study, we examine the challenges involved in changing an existing implementation of a PACS system for ophthalmic image acquisition and storage from using the Photographic Visible Light IOD to using the new OP and Stereometric Relationship IODs. We demonstrate how workflow in ophthalmic photography may be used to drive selective recording of a subset of acquisition parameters suitable to the images being captured. This is achieved through the use of configurable acquisition environments for procedures, such as acquisition of a Colour series or a Fundus Fluorescein Angiography series. These may be started stand-alone on the workstation or may be tied in to Modality Worklist. We describe how additional parameters for stereo viewing can be recorded and stored in the Stereometric Relationship module within the existing stereo viewing framework of the O-PACS Image Capture software. We discuss practical problems associated with the recording of certain mandatory attributes in the modules of the OP IODs in a clinical setting and make suggestions for improvements. Finally we conclude that the new OP and Stereometric Relationship IODs go a long way to bridge the gap between ophthalmology and radiology DICOM, but require serious considerations about how to filter and capture the new supported acquisition parameters.

[9:25 – 9:45] B105: The Integration of Whole Slide Imaging in the Clinical Anatomic Pathology – Limitations of Laboratory Information Systems, Image Capture Systems and Archives – 20 min

Yukako Yagi; Drazen Jukic, M.D., Ph.D.; Anil Parwani, M.D.; Jon Ho; William Gross; Ellen Kokal; Tony Piccoli; Michael Kistler; John Gilbertson, M.D. [Centers for Pathology and Oncology Informatics, Department of Pathology, University of Pittsburgh Medical Center (UPMC)]

Background: The past five years has seen the emergence of whole slide imaging robots – devices that can automatically image entire microscope slides at high speed and high resolution. A typical device can capture a slide in 5 minutes at tissue sampling rates of 0.3 microns/pixel, resulting in an uncompressed image file of 5 to 10 GB, and a typical pathology case contains ten slides. Though these "high resolution whole slide images" provide diagnostic information similar to that obtained by direct examination of tissue under the microscope and are proving useful in a variety of clinical activities; their novelty and sheer volume has resulted in a number of image and data management challenges. One of these challenges is that Laboratory Information Systems, which drive workflow and data management in pathology departments, are not well equipped to manage image level information.

Methods: At the University of Pittsburgh, we have developed an infrastructure for the clinical use of whole slide imaging (WSI) including the implementation of different types of imaging robots, imaging quality assurance protocols, compression and storage mechanisms, mechanisms to serve whole slide images throughout the medical center, slide image viewers and a team of pathologists, imaging scientists and engineers dedicated to the evaluation of whole slide imaging systems in the clinical environment.

It was quickly realized that for the clinical evaluation of WSI to be realistic, images had to be managed (or at least accounted for) within the Laboratory Information System (LIS). The team, assisted by personnel form central IT and Radiology, examined 1) The image information needs of the pathologist, histologist, imager and image data manager and how these needs can be accommodated in with the LIS and Pathology Imaging Systems and 2) Mechanisms by which specific systems – the Copath C/S Laboratory Information System, the Aperio T2 Whole Slide Imager and UPMC's DICOM Compliant Enterprise Image Archive - could share images and image information in support of clinical evaluations.

Results and Discussion: The work revealed a number of structural and procedural issues in the LIS, Imaging System and Archive the hindered the implementation of large scale imaging in pathology. Some of these issues include 1) LIS systems did not support the concept of an whole slide image, 2) Current pathology imaging systems did not well support the "groups of associated images (i.e. "series") and 3) the DICOM archive had difficulties with the size of the WSI and the proprietary internal structure of some of the WSI image files. The team implemented a series of

work-arounds for these problems and tested them as part of clinical evaluations. On the basis of there results, we are working to develop long term solutions.
Work to be presented: In this paper we describe the nature of whole slide images and integration of whole slide imaging into the existing workflow of a pathology department. Using an image v glass slide equivalence study in anatomic pathology quality assurance as a context, we will discuss changes required in the Laboratory Information System (LIS) and Histology Laboratory to support image level information, departmental decisions surrounding the dissemination of images, the integration of imaging systems and the LIS and the development of a "DICOM wrapper" to communicate gross and histological images from Pathology to an Enterprise Image Archive.

[9:45 – 10:05] B106: Interoperablity Issues in Image Registration and ROI Generation – 20 min

Todd Kantchev [CTI Mirada]

This paper presents the problems of generating DICOM compliant multi dimensional data after image registration from multiple modalities: PET, NM, CT, MR. The limitations of the existing DICOM IODs are explained and the process of derivation of registered image data is described. It is shown how issues like correct image identification and grouping, patient positioning, image geometry, overlays and others are resolved and how the consistency between the original and the new, processed data is preserved.
The presentation further explains how similar problems in contouring on fused image data can be resolved to assure consistency of the image geometry and the volume contours, as well as the observation data (type of ROI, interpreted type, physical property etc.).
Some workflow issues in that context are discussed for specialized areas like RT planning and image fusion. The pros and cons of direct data transfer between equipment of different manufacturers, participating in the workflow, are explained and the possibilities of using short term and long term intermediate storage are examined. Different levels of workflow service are proposed for PACS environment, based on the considerations of the IHE Scheduled Workflow.
New developments in DICOM like multi-frame CT and MR, Spatial Registration, Color Presentation States and the need for new integration profiles using the General Purpose Work List, are also briefly introduced.

[10:05 – 10:35] Break – 30 min

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[10:35 – 12:15] Session 2: Reporting and Workflow – 1:40 hrs

Chair: Allan G. Farman, D.Sc., Ph.D.; [Dept. of Surgical and Hospital Dentistry, The University of Louisville]

[10:35 – 10:55] B201: Defining Clear and Complementary Roles for HL7 CDA (Clinical Document Architecture) and DICOM SR (Structured Reporting) in Diagnostic Reporting – 20 min

Fred Behlen, Ph.D. [Laitek]

DICOM Structured Reporting (SR), added to the Standard in 1999, provided the capability for integration of reporting with imaging, but its adoption has been limited because reporting functions have remained in information systems based primarily on Health Level Seven (HL7) standards. In addition, the end recipient of diagnostic reports – referring physicians – commonly uses systems with HL7 rather than DICOM capabilities. DICOM and HL7 working groups recognized the need to work together to define standard methods for reporting that meet the needs of practice in today's environment.

The process gained momentum in 2003 with elaboration of use cases for varying types and purposes of diagnostic reporting. These use cases were presented by Dr. Helmut Koenig at the DICOM 2003 International Conference & Workshop. Standards solutions were considered against these use cases, and gaps were identified and subsequently closed through extensions to the standards. The efforts have included discussions in many working groups of DICOM, the issuance of DICOM Supplement 101 (HL7 Structured Document Object References), plus continued cooperation with the HL7 Structured Document Technical Committee, which edits the CDA.

As a result of these efforts, the roles of DICOM SR and HL7 CDA have been clarified and sharpened. Imaging results documents were classified as either "Evidence Documents" or "Reports".

- Evidence Documents include ultrasound measurements, cath lab structured reports, Computer-Aided Diagnosis results, etc., that are created in the imaging systems context. Evidence Documents, together with images, are part of the information that a radiologist uses to produce a report. The reporting physician may quote or copy parts of Evidence Documents into the report, but doing so is part of the interpretation process at the reporting physician's discretion. Evidence documents are stored with the images, and DICOM SR clearly being the correct format.
- The Reports become part of the patient's medical record, for which the HL7 CDA was considered ideal, but the structured data entry capabilities needed for diagnostic reporting would be available only in CDA Release 2.

CDA Release 2 is now published in 2005, and all needed standards are now in place. Additions to DICOM in Supplement 101 allow inclusion of CDA reports on DICOM removable disks, and define communication of simple image references and annotation from PACS to reporting systems without requiring close integration of the two systems.

Thus, standards now available support practical and complementary roles of DICOM and HL7 standards at the reporting interface. The presentation will show examples of SR and CDA documents in these roles, and illustrate the systems connections needed to implement them.

[10:55 – 11:15] B202: DICOM Composite Objects References in HL7 Version 3 in the Context of the Clinical Statement Pattern, the Clinical Document Architecture and DICOM Web Access to Persistent Objects (WADO) – 20 min

Helmut Konig, M.D. [Siemens Medical Solutions]

Supplement 101 "HL7 Structured Document Object References" has been released for letter ballot in April 2005. The focus of this supplement is on DICOM references to HL7 structured documents (i.e. Clinical Document Architecture, CDA documents). It also covers CDA DICOM composite object references, using a combination of WADO (Web Access to DICOM Persistent Objects) references in the CDA narrative text and a structured representation of the associated Study/Series/Instance context contained in the "DICOM Object Catalog" CDA section. This CDA section is meant to provide the essential information on the referenced significant DICOM SOP instances (Fig. 1).

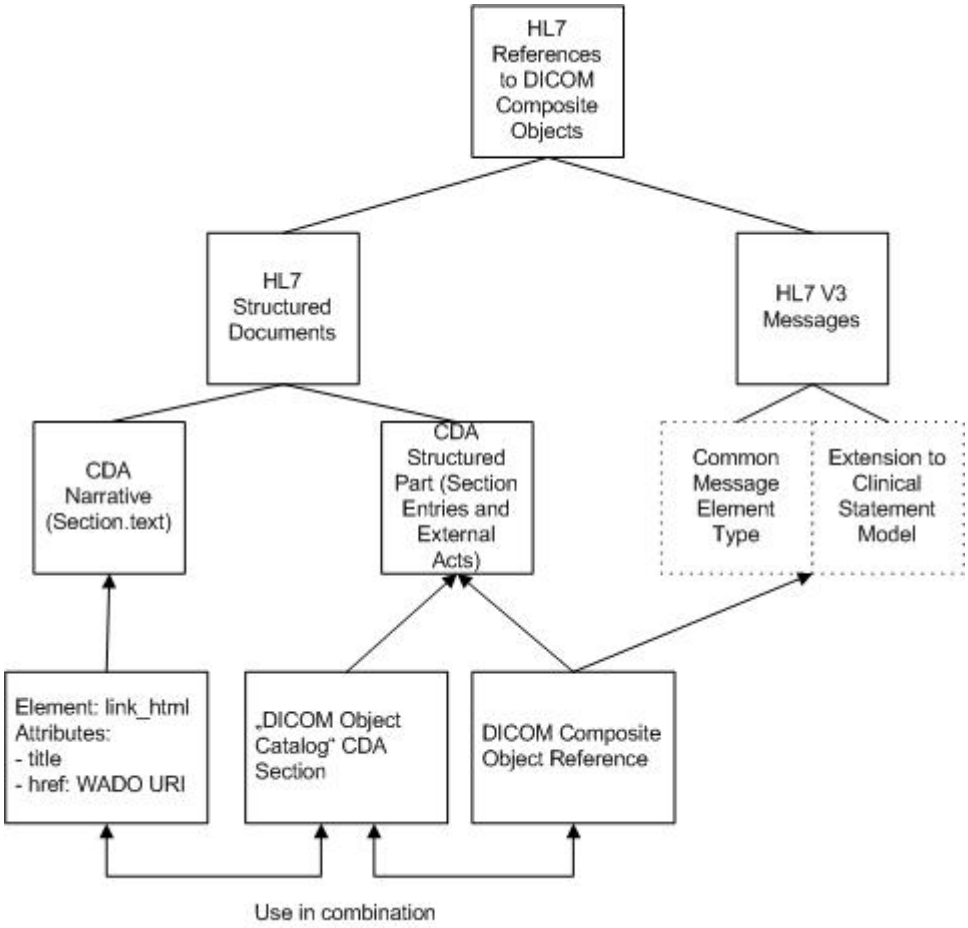

Figure 1: HL7 References to DICOM Composite Objects

In order to cover the use cases:

- Plain DICOM composite object references (including non-image objects),
- References to DICOM images with an associated presentation state,
- References to DICOM multi-frame images

DICOM WG20 has started the discussion on an extended structured DICOM composite object reference model (Fig.2).

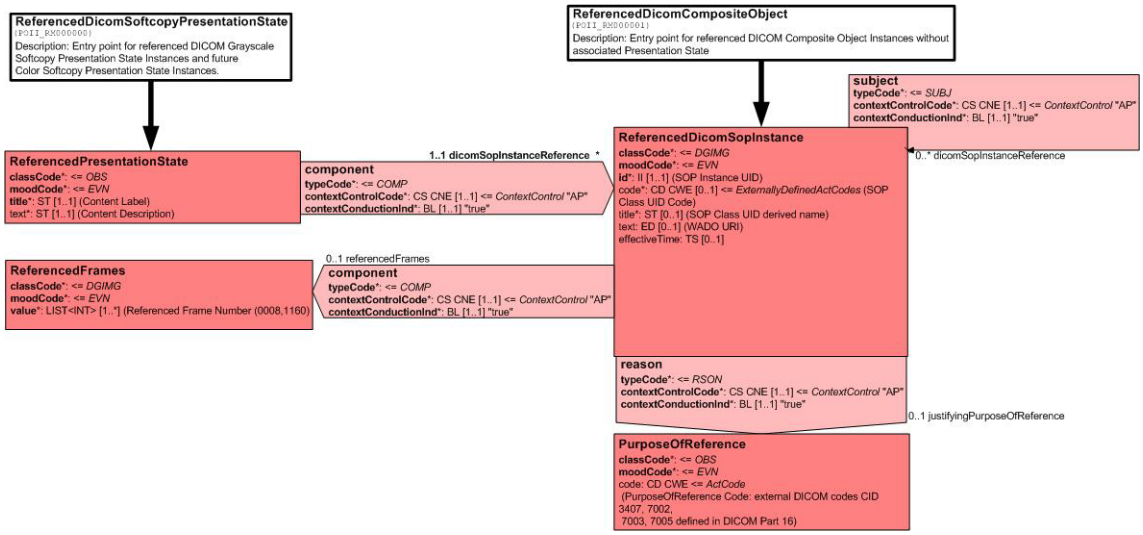

Fig. 2: HL7 V3 DICOM Composite Object References

The goal is to harmonize the use of DICOM references with HL7 V3 messages and documents by providing a generic common message element type or an extension to the clinical statement pattern model. The HL7 clinical statement pattern is intended to facilitate the consistent design of communications that convey clinical information. Its specification is a joint effort of the HL7 Orders and Observations, Patient Care and Structured Documents Technical Committees. The impact of the clinical statement pattern and WADO on the representation of DICOM composite object references will be outlined.

[11:15 – 11:35] B203: Issues Regarding Functional MRI Imaging Workflow and DICOM – 20 min

Lawrence Tarbox, Ph.D.; Fred Prior, Ph.D. [Mallinckrodt Institute of Radiology, Washington University in St. Louis School of Medicine]

[Replacement for the previously announced talk]

Despite the availability of DICOM for storing and transmitting MRI images, very few of the researchers and clinicians involved with functional MRI utilize DICOM formats for their intermediate results or their final images. DICOM is merely used as a means to get the base data out of the scanners, which the researchers and clinicians routinely convert to one of several competing, non-DICOM formats for subsequent processing. This presentation explores the workflow involved in creating functional MRI images, the various formats currently employed to store intermediate and final results, and the reasons why DICOM has not generally been used in functional MRI circles. Although the new multi-frame MRI object defined in DICOM addresses some of the previous shortcomings, issues still remain.

[11:35 – 11:55] B204: A Practical Implementation of the General Purpose Worklist Standard for Efficient Access to Ward and Clinic Lists – 20 min

S. Claesen, Ph.D.; C.F. Nielsen, Ph.D. [ComMedica Limited]; R.I. Kitney, D.Sc. (Eng), Ph.D. [Dept of Bio engineering, Imperial College of Science]

This paper describes the implementation of the General Purpose Work List (GPWL) as part of a generic PACS workstation. The GPWL functionality is used in two particular areas: firstly, it provides a reporting work list for the radiologist, and secondly it provides lists of patients attending a clinic or present on a ward. The paper will concentrate on the second of these areas.
The clinic and ward list functionality is particularly useful for clinicians who require access to diagnostic images but do not necessarily have access to a RIS or full RIS-PACS integrated

workstation. An example of such a user is an orthopaedic consultant running a weekly clinic. Currently, these clinicians have to perform extensive queries to retrieve the appropriate studies for the patients attending their clinic. The GPWL functionality described in this paper allows a short list of relevant patients to be shown on login, without having to search through long lists of irrelevant studies.
The specific example used in this paper is the ComMedica PACS system. It uses configurable coding schemes and values to define the GPWL queries. This allows the system to work with any PACS server that supports GPWL. Predefined coding schemes, values and friendly names can be loaded into the system using XML configuration files. This makes the system extremely user friendly as the details of coding schemes are hidden from the user. The ComMedica Image Viewer can also make use of the user identity extended negotiation (as defined in Part 15 of the Dicom 3.0 standard) to authenticate the logged in user.
The ComMedica PACS server will maintain a copy of attendance lists. The server is kept up to date with ward and clinic attendance using standard HL7 v2.4 messages. These lists can then be associated with different coding schemes and values to serve GPWL queries to workstations. Whilst this adds complexity to the system, it does have a number of advantages including high availability, reduced response times, scalability, and vendor independence in relation to GPWL.

[11:55 – 12:15] B205: Workflow in the Operating Room: Review of Arrowhead 2004 Seminar on Imaging and Informatics – 20 min

Heinz U. Lemke, Ph.D. [Dept. of Computer Graphics & Computer Assisted Medicine, Technical University Berlin]; Osman M. Ratib, M.D. [UCLA Radiological Sciences]; Steven C. Horii, M.D. [University of Pennsylvania, Department of Radiology]

This review is based on the 2004 UCLA Seminar on Imaging and Informatics which is a joint endeavour between the UCLA and the CARS organization, focussing on workflow analysis tools and the digital operating room (http://www.radnet.ucla.edu/Arrowhead2004/). Eleven specific presentations of the Arrowhead Seminar have been summarized in this review referring to redesigning perioperative care for a high velocity OR, intraoperative ultrasound process and model, surgical workflow and surgical PACS, an integrated view, interactions in the surgical OR, workflow automation strategies and target applications, visualisation solutions for the operating room**,** navigating the fifth dimension, and design of digital operating rooms and interventional suites. The need and possible steps towards a DICOM and IHE in Surgery can be derived from this summary and will be outlined in this presentation.

[12:15 – 13:15] Lunch – 1 hr

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[13:15 – 14:55] Session 3: Compression and Presentation – 1:40 hours
Chair: Csaba Szabo, Ph.D.; [Budapest Univ. of Technology and Economics]

[13:15 – 13:35] B301: The New JPEG 2000 Part 2 Multi-Component Transfer Syntaxes – 20 min
Alexis Tzannes, Ph.D. [Aware, Inc.]

JPEG 2000 (ISO/IEC 15444) is the most recent suite of ISO standards for still image compression. Part 1 of the standard describes the core coding system, specifying both lossy and lossless compression and decompression. Supplement 61 of the DICOM standard described new transfer syntaxes that added support for Part 1 of the JPEG 2000 Standard.
Part 2 of JPEG 2000, entitled Extensions, includes extensions to many of the technologies in Part 1 of the JPEG 2000 Standard. The multi-component transformation extensions allow for the use of wavelet transformations and array based transformations in the component direction, for multi-component or multi-frame imagery. For multi-spectral and 3D volumetric data it has been shown that the JPEG 2000 Part 2 Multi-component Transformation extensions can improve compression efficiency, for both lossless and lossy compression. For lossless compression, the improvement has been shown to be about 5-25%, depending on the type of images. More significant improvements have been observed for lossy compression.
Recently, Supplement 105 of the DICOM Standard has been drafted to describe new transfer syntaxes that add support for this Part 2 JPEG 2000 multi-component transforms. The supplement allows for both lossless and lossy transforms to be applied in the third dimension. The wavelet transforms from Part 1 of JPEG 2000 and array based transformation are both allowed. The supplement also allows for the use of component collections, which are groups of components that are processed independently. The use of component collections can be used to reduce computational complexity and to improve access to specific frames on the decoder.
This presentation will review the status and describe the contents of Supplement 105. The various allowed multi-component transformation techniques will be described and analyzed in detail. Representative results of using these new techniques to compress volumetric data will also be included. A demonstration of applying the multi-component transformations to volumetric data will also be presented.

[13:35 – 13:55] B302: JPEG2000 Interactive Protocol and DICOM Supplement 106: Extending DICOM Capabilities through the Addition of Standard-Based Image Streaming – 20 min
Lev Weisfeiler [Aware, Inc.]

JPEG 2000 (ISO/IEC 15444) is the most recent suite of ISO standards for still image compression. Part 1 of the standard describes the core coding system, specifying both lossy and lossless compression and decompression. Supplement 61 of the DICOM standard described new transfer syntaxes that added support for Part 1 of the JPEG 2000 Standard.
Part 9 of the JPEG 2000 Standard defines JPIP, the JPEG 2000 Interactive Protocol. JPIP was approved as an International Standard in October 2004. JPIP has been proposed for inclusion in DICOM through Supplement 106, which is currently out for public comment.
JPIP is a guide for the best and most efficient transfer of JPEG2000 image data across a network. Currently DICOM supports only complete object transfer while JPIP provides the syntax and

structure of a network protocol for the interactive and progressive transmission of JPEG2000 images from a server to a client. Intelligent caching provides for the request and receipt of just the necessary building blocks (databins) of the JPEG2000 codestream while maintaining mechanisms for support of other image formats. The client application therefore needs only request the particular region of interest, a quality layer, or resolution level required for a specific task. Supplement 106 calls for separating the transmission of the pixel data from the other attributes in the DICOM dataset.
JPIP increases the usefulness of DICOM for bandwidth constrained distributed applications and represents a standardized approach to streaming pixel data across networks. The protocol proves useful for medical applications by making the most efficient use of available server, client, network, and user resources. Reduced processing, transmission, and wait-times mean lower costs, and increased efficiency of distributed medical applications and their users.
This presentation will present an overview of the functionality and features of the JPIP protocol. The presentation will also describe the contents and review the status of DICOM Supplement 106. A software demonstration of using JPIP in DICOM will also be presented.

[13:55 – 14:15] B303: Experiences of Using the Microsoft Windows DirectShow Architecture to Handle the DICOM MPEG-2 Transfer Syntax – 20 min

Dave Harvey [Medical Connections]

The addition of the MPEG-2 Transfer Syntax to the DICOM standard (DICOM Supplement 42, 2003) had been widely anticipated by both users and vendors, but it presents some novel challenges to developers without previous MPEG experience. In particular, many developers need to be able to make their applications work on a wide variety of different computer and video hardware, and whilst most video cards and drivers have good support for video, this often hardware-specific. Under the Windows operating system, the most common solution adopted in the consumer entertainment market is the Microsoft DirectShow architecture, which enables disparate video sources, codecs and display devices to be used in combination by having their input and output "pins" connected together to make a functioning system. This architecture provides support for both the video and audio streams in MPEG-2 data.
This approach has proved feasible for MPEG-2 data encapsulated into DICOM instances, but there were some problems which needed to be overcome, such as:

- Ensuring that MPEG video data is MPEG-2
- Making the encapsulated MPEG-2 data and uncompressed pixel data compatible with the formats expected and provided by DirectShow
- Enabling and controlling conversion to uncompressed or frame-by-frame compressed transfer syntaxes
- Coping with deficiencies in some commonly available codecs

This presentation will cover the following areas:

- A review the DICOM MPEG-2 requirements (supplement 42)
- An overview of the Microsoft DirectDraw architecture
- Practical experience of using DirectShow with DICOM data
- Potential pit-falls and solutions
- Performance considerations.

[14:15 – 14:35] B304: User Interface Issues for DICOM Presentation States – 20 min

Dave Harvey [Medical Connections]; C.F. Nielsen, Ph. D.; S. Claesen, Ph.D. [ComMedica Limited]; R.I.Kitney, D.Sc. (Eng), Ph.D. [Dept of Bio engineering, Imperial College of Science]

The use of DICOM presentation states to control the display of DICOM images is now well established, but there are many complexities concerning the choice of which presentation state to use for any particular DICOM Image, and this choice must influence the associated user interface. In particular, the rules for presentation states provide great flexibility, allowing a presentation state object to be applied to whole series, individual images, or even just individual frames, and this does complicate the decision of which to present to the user as the default. This is a significant problem where multiple presentation states exist for a particular image or set of images, and it is compounded where the presentation states have only partially overlapping applicability, so that moving from one image to another within a series forces a change of presentation state.
It is important for efficient user workflow that a suitable default choice of presentation state should be made, whilst still maintaining user access to all available presentation states, and without causing unnecessary disruption when moving between images.
We describe possible mechanisms to automate the choice of default presentation states from those available and the associated user interface elements required to make presentation states usable and efficient for users in the real world. In particular, the use of means to "rank" presentation states is discussed, including how the algorithms chosen may need to vary according to the user and intended use of the images.

[14:35 – 14:55] B305: Standardization of Hanging Protocols – 20 min

Paul Morgan [FujiFilm]

In current implementations, PACS workstations provide a means to compose Hanging Protocols specific to reading scenarios and to propagate them to similar studies. Traditionally, these protocols keyed off Series- and Equipment-specific attributes such as Modality, Series Description and Manufacturer. In rare cases the view, laterality and anatomic region are taken into account, but always in an application-specific manner and rarely with the ability to be used across an enterprise on different workstations. Additionally, the workstations in the enterprise have differing display capabilities and Hanging Protocols are typically created separately for each of these screen layouts.
Supplement 60 "Hanging Protocols" provides a means to obtain the automatic and consistent hanging of images according to definitions provided by the users, sites or vendors of the workstations by providing the capability to:

- Save defined Hanging Protocols
- Search for Hanging Protocols by name, level (single user, user group, site, manufacturer), user identification code, modality, anatomy, and laterality.
- Allow automatic hanging of image sets to occur for all studies on workstations with sufficiently compatible capabilities by matching against user or site defined Hanging Protocols. This includes supporting automatic hanging when the user reads from different locations, or on different but similar workstation types.

The Hanging Protocol Composite IOD contains information about user viewing preferences, related to workstation capabilities. The associated Service Classes support the storage (C-STORE), query (C-FIND) and retrieve (C-MOVE) of Hanging Protocol Instances between servers and workstations.
How relevant image sets (e.g., from the current and prior studies) are obtained is not defined by the Hanging Protocol IOD or Service Classes.
Conformance with the DICOM Grayscale Standard Display Function and the DICOM Softcopy Presentation States in conjunction with the Hanging Protocol IOD allows the complete picture of what the users see, and how they interact with it, to be defined, stored and reproduced as similarly as possible, independent of workstation type. Further, it is anticipated that implementers will make it easy for users to point to a graphical representation of what they want (such as 4x1 versus 12x1 format with a horizontal alternator scroll mechanism) and select it.

[14:55 – 15:25] Break – 30 min

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[15:25 – 17:30] Session 4: Applications and New Directions – 2:05 hrs

Chair: Lawrence Tarbox, Ph.D. [Mallinckrodt Institute of Radiology, Washington University in St. Louis School of Medicine]

[15:25 – 15:45] B401: The Use of DICOM by Branches of the United States Federal Government – 20 min

Dezso Csipo [Object Forge, Inc]; Mike Henderson [Eastern Informatics, Inc.]; Eric Goodall [IBM]

The presentation is planned as an informative overview of the usage of DICOM by a number of selected federal Agencies. These agencies are the Department of Defense, the Veterans Administration, the National Institute for Health, the Department of Health and Human Services, the Indian Health Service and the National cancer Institute. The audience will be introduced to the role of these agencies in delivering healthcare or in advancing the state of the current heath care deliver system. The presentation examines current usage of commercial systems, current internally developed DICOM compliant systems, future commercial system purchase plans and the planned development of new DICOM compliant systems. There will be information presented about the various initiatives targeted at implementing digital imaging implementation by these agencies (like MDIS and DINPACS) and the conformance and interface requirements developed or co-developed by the agencies listed above. The audience will be introduced to the various organizations within the federal government tasked to develop inter agency information sharing; the role of these organizations will be presented in detail. There will be additional information about the various federal projects (past, present and future) targeted at sharing medical information between the various agencies.
The presentation will devote a section to the relation of the various agencies to the standards organizations and industry consortiums (DICOM, HL7, IHE etc), the use of the industry standards in establishing development or purchasing priorities.

[15:45 – 16:05] B402: A New Method for Increasing the Flexibility of DICOM Tags Management in Application-Specific Integration – 20 min

Charles Florin, Mazen ElBawab, Fred S. Azar, Ph.D. [Siemens Corp. Research]

The DICOM format uses predefined tags, and allows the definition of new tags, which may or may not be present for a given dataset. This flexibility is one of the features that made DICOM format so popular for medical imaging. Nevertheless, this popularity has led to the multiplication of tag definition, and consequently, it is sometimes difficult to know which tags are used, and what they mean. The number of tags which may or may not be present makes the import/export tools increasingly complex for integration in medical imaging applications. Consequently, the import/export tools tend to be more application specific, thus limiting the portability for other applications and platforms. For this reason, we propose a new flexible method, which allows the user to select/define a set of application-specific tags, out of a tags dictionary. This method thus takes full advantage of DICOM flexibility, and allows the user/developer to customize an initialization file specific to his/her application. This file specifies the way by which DICOM volumes are differentiated, ordered and labeled. The user-defined initialization file also gives the possibility to add private tags, which are not defined in the DICOM standard or in the proposed tags dictionary, thus providing the user with added flexibility.

The following is a suggested workflow used in the method's implementation:

- First, the user may customize an initialization file specific to each DICOM dataset of interest,
- In case the initialization file does not exist for a particular dataset, a set of pre-defined application-specific tags are used as default. This default set of tags may also be customized by the user,
- In order to import/export a specific dataset, the user selects the desired import/export directory,
- For an import operation, the volumes present in the specified directory are read and ordered according to the initialization file, then imported in a format compatible with the application,
- For an export operation, the volume is exported in DICOM format, along with all the user-defined tags.

This method is flexible enough for use in various contexts, such as:

- Imaging modalities: perfusion or angiography,
- Application-specific data: contour sequences for image segmentation,
- Novel imaging modalities: molecular or optical imaging.

A relevant example in the practical use of this method is within the official NTROI (Network for Translational Research in Optical Imaging) imaging software platform. As a member of the NTROI, SCR is developing the Optical and Multimodal Imaging Platform for Research, Assessment and Diagnosis (OMIRAD). A major goal of this platform is to enable multimodal integration and visualization of diffuse optical tomography (DOT) and other known imaging modalities (MRI, X-ray) in breast cancer imaging. One of the challenges in implementing the OMIRAD platform is how to represent and store the DOT image format along with the numerous parameters for image acquisition and 3D reconstruction. A popular format, TOAST (Time-resolved Optical Absorption and Scattering Tomography), is widely used today for DOT image reconstruction. The OMIRAD platform uses TOAST in order to import DOT data. The proposed import/export method enables the export of the DOT volume to DICOM format through user-defined tags, thus bringing an initial "standard" to the DOT image format. The exported DOT data can then be imported by any other DICOM-supporting platform.
In conclusion, as imaging technologies are developing faster than the data format standardization procedures, the suggested method leads to a more flexible import/export tool in application-specific integration.

[16:05 – 16:25] B403: Classification and Normalization of the Structural and Semantic Constraints Used by the Digital Imaging and Communication in Medicine (DICOM) Standard – 20 min

Dongbai Guo, Ph.D. [Oracle USA, Inc.]

Purpose: Our goal is to find a canonical representation of the structural and semantic constraints used by the DICOM standard.
Problem Statement: The DICOM standard uses narrative text to specify the structural and semantic constraints of a SOP class. These constraints can either be part of the attribute definition or part of the section notes. Although a human can interpret these constraints easily, it is extremely time consuming to map these constraints into a program construct in order for a computer to efficiently validate the conformance of a DICOM object.
Method: We define a constraint to be a conditional statement of the DICOM standard that is verifiable at the receiving end. If a DICOM object fails a conditional statement, it is considered not conformant to the DICOM standard. We tried to examine all the conditional statements in the DICOM standard to classify them into structural and semantic constraints. We found that certain statements, although listed in the standard as the condition for the presence of an attribute, are

nevertheless impossible to verify by the receiving-end of a DICOM object. We therefore do not consider statements such as these as structural or semantic constraints.
Except in certain rare cases, the rest of the conditional statements in the DICOM standard can be classified into seven major constraint categories:

1. Context sensitive attribute value,
2. Enumeration,
3. Cardinality,
4. Reference integrity,
5. Choice,
6. Context sensitive structure,
7. Context sensitive data type.

Among them, context sensitive attribute value and enumeration are the most widely used constraint categories. For these major categories, we demonstrate that:

1. A constraint may involve one or more attributes,
2. A constraint can be canonically defined as a simple predicate that can be mapped into an XPath statement or a procedural language construct that can be encoded into XML,
3. A constraint can be efficiently validated if a small set of properties is computed for each DICOM attribute,
4. Certain predicates are repeatedly referenced in the definition of a DICOM object and therefore their results can be cached to improve the performance of the validation.

Note that a small number of constraints in the DICOM standard cannot be classified into the major categories described above and are not easily expressible as predicates; therefore they have to be special-cased in a validation program.
With this classification and normalization of DICOM constraints, we expect future DICOM standard development efforts such as XML publishing to be significantly simplified. In addition, having a canonical representation of a constraint may help to formalize its usage in the DICOM standard, in the same manner as value representation (VR) is used today in the DICOM standard.
Conclusions: The classification and normalization of DICOM constraints can lead to more accurate and concise specification of DICOM conformance conditions. It will enhance the readability of the DICOM standard, normalize the validation of its conformance, and simplify the optimization of an automated validation program.

[16:25 – 16:45] B404: Integrating Digital Imaging and Communication in Medicine (DICOM) Objects with a Database Management System – 20 min

Dongbai Guo, Ph.D. [Oracle USA, Inc.]

Purpose: We define a framework for tightly integrating DICOM objects with a database.
Problem Statement: Traditionally, a DICOM object is either stored outside of a database as an operating system file or indirectly managed by the database through a pointer to the file. With the increased demand in data security, manageability and scalability, integrating DICOM objects tightly with a database management system become an urgent task.
Method: We describe a framework in which to integrate DICOM objects into an object-relational database.
In our design, a DICOM object is encapsulated as a database object with a set of functions to interpret, manage, and process its content. The object definition is loaded into a system schema and is installed with the database. Through the database object, a user may invoke a set of member functions that are implemented with database stored procedures. This functionality is built on top of a data dictionary and attribute constraint management module that guides the parsing and enforces the conformance of a DICOM object to the DICOM standard. The database objects that encapsulate DICOM objects can be natively indexed to allow efficient retrieval of a DICOM object by its attributes.

At runtime, a user may import the content of a DICOM object into a database object. The database object may store either a compressed copy of the DICOM object or a bit-wise identical copy of the original DICOM object. The database stored procedures can parse the DICOM content and extract its attributes. The extracted attributes can be encoded into an XML document. One may create an XML index on the database table column which stores the extracted XML metadata documents, and use XPath queries to target the search to logical combinations of multiple DICOM attribute-value conditions. Alternatively, one may also create a full text index to query all attributes by keywords. In addition, the content of the DICOM object can be processed and converted. A sample usage of this functionality is to make a JPEG copy of a DICOM object for the integration with a web access to DICOM objects (WADO) server.
One advantage of our design is that the stored procedures for parsing and validation of the DICOM object are completely driven by user modifiable data dictionaries and constraint definitions. Therefore a user may enforce a set of conformance rules that are stricter than what are defined by the DICOM standard. For example, a user may mandate that patient name be not null for all DICOM objects stored in a particular database.
With this solution, DICOM objects can be stored together with other patient, lab, and research data therefore enabling data sharing, data mining, and centralized management. It can also significantly simplify the image integration of an electronic health record (EHR) system.
Conclusions: We describe a method to tightly integrate DICOM objects with a DATABASE. With our design, a DICOM object can be stored, queried and managed just like any other traditional data such as strings or numbers. As a result, a DICOM application built on top of such a database can take full advantage of database features such as scalability, security, manageability, and transaction control.

[16:45 – 17:05] B405: The Extension of the DICOM Standard to Incorporate Omics Data – 20 min

R.I.Kitney, D.Sc. (Eng), Ph.D. [Dept of Bio engineering, Imperial College of Science];
C.F. Nielsen, Ph.D.; S. Claesen, Ph.D. [ComMedica Limited]

The move towards fully web-based clinical information systems (CIS) is a rapidly developing trend in healthcare. At one level research and development on advanced CIS involves the integration of a range of current types of information systems (EPRs, PACS, RIS etc) into a common, integrated information environment. Current CIS, of which the above are examples, mainly operate at the systems, visceral and tissue levels of the human organism. However, with the rapid developments which have occurred in molecular and cellular biology, it is now becoming important to incorporate information from other levels of the human organism. To describe this range of information, we have coined the term "The Biological Continuum" or BC – this comprises the levels from systems to genes (i.e. systems, viscera, tissues, cells, proteins and genes). Key features of the new type of CIS will comprise the ability to input data from a wide range of sources and to navigate seamlessly across the BC. Currently, at the higher levels of the BC (namely, at the system, viscera and tissue levels) data are frequently presented in DICOM format; however, this does not apply at the lower levels. We are now extending the DICOM standard to incorporate to genomic and proteomic data For the higher levels of the BC, in the DICOM standard data (e.g. images) are often formed into a hierarchy comprising Patient, Study, Series and Image. For OMICS data (i.e. genomic, proteomic, metabonomic) we are developing new DICOM modules, with different attributes, which are compatible with the new data types. For example, protein data are being represented and stored in terms of their basic attributes (e.g. for the purposes of efficient storage). A special rendering module allows the protein structure to be viewed and manipulated in 3D. Conversely, DNA sequences are linear, one dimensional structure. Hence, incorporation into the DICOM standard requires a different type of module. In addition, the new modules have to be flexible enough to incorporate time variant features and the use of analytical techniques (e.g. based SNP mapping). Another important aspect of our research on the new generation of CIS is seamless navigation across the BC. This creates the need for common data handling system which converts data from a

range of modalities into DICOM format. This is part of a visualization and navigation environment which provides geometrical integrity across all the levels of the BC - despite the fact that the data at different levels may well be from different modalities.

[17:05 – 17:25] B406: DICOM Application Hosting: A Mechanism for Deploying Medical Post-Processing Software in a Machine-Neutral Fashion – 20 min

Lawrence Tarbox, Ph.D. [Mallinckrodt Institute of Radiology, Washington University in St. Louis School of Medicine]

The post-processing of collected image sets is becoming an increasingly important aspect of clinical workflow. Disciplines such as molecular imaging, CAD, treatment planning, etc. depend on post-processing algorithms for their workflows. Ideally, the creators such of post-processing algorithms would like to produce a single piece of software that could be deployed to a wide variety of host environments with little or no modification. Researchers could also benefit from the ability to create post-processing modules clinical trials that could be executed in the context of clinical computing systems. DICOM Working Group 23 is creating an Application Program Interface (API) that will allow any application system to host a post-processing application (a medical imaging "plug-in"), and efficiently exchange information with that post-processing application using DICOM semantics. The Working Group is also developing meta-data that would allow a hosting application system to discover the types of "plug-ins" available for use, and what their operating requirements are.

[17:25 – 17:30] Concluding Remarks – 5 min

[19:00 – 21:00]

Four Course Banquet including a Presentation by András Jávor, MD

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Director, Institute for Medical Informatics, Semmelweis University, 2002-
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Senior advisor of the Health Minister in Public Health and Medical Informatics, 2001.;
Chief of the National Council for Medical Informatics, 2001-2003;
President of the Hungarian Public Health Association, 2000-2004; Vice-president 2004-;
Chairman of the Hungarian Working Group for Information Societies Technologies of the NATIONAL COMMITTEE for TECHNOLOGICAL DEVELOPMENT , 1999-2002;
Deputy Head of the National Health Insurance Reform Committee, 1998-2000;
Chief of the Board of the Public Foundation for Technology Assessment in the Health Care, 1998-;
International consultant in health policy, public health and medical informatics, 1994- ;
Managing Principal of SANITARIUS Consulting L.P., 1997-;
Permanent Secretary of State, Ministry of Welfare, 1990-94;
Head of the Health Reform Secretariat, Ministry of Social Affairs and Health Care, 1988-1990;

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Molecular Imaging's Impact on DICOM

[8:30 – 8:35] Welcome – 5 min
Chair: Cor Loef [Philips Medical Systems]

[8:35 – 9:15] C1: Healthcare 2010 – Our Vision of Molecular Medicine – 40 min
Sebastian Schmidt, MD
Manager Business Development
Siemens Medical Solutions
Erlangen, Germany

Dr. Sebastian Schmidt is Manager Business Development at Siemens Medical Solutions. In his current position, he works on implementing Siemens' strategy in the field of molecular medicine, including molecular imaging and in-vitro diagnostics.

Dr. Schmidt's previous experience includes service as:

- Investment manager for a German venture capital firm; investment focus was the life sciences industry and information technology.
- Head of software development at a German healthcare services provider.
- Two years residency in diagnostic radiology.

Dr. Schmidt studied medicine at the Free University of Berlin and the University of Freiburg (Germany). Work for his doctoral thesis was performed at the Institute for Molecular Biology and Bioinformatics, Free University of Berlin.

[9:15 – 10:00] C2: The Contribution of Correlative Imaging to Molecular Medicine – 45 min
Torsten Kuwert, MD
Director and Professor of Clinical Nuclear Medicine
Clinic of Nuclear Medicine
Friedrich-Alexander University
Erlangen, Germany

Torsten Kuwert (*19.12.1958) received his approbation as medical doctor and his MD degree from the Technical University of Aachen, Germany, in 1983 and 1987, respectively. After military service he entered the Institute of Medicine of the Research Center Jülich and was among the first in Germany to use positron emission tomography (PET) for research and clinical purposes. His habilitation thesis dealing with PET imaging of the brain was accepted by the Faculty of Medicine of the Heinrich-Heine-University of Düsseldorf in 1993.

From 1994 to 1998 he continued using emission tomography for molecular imaging of, in this case, brain tumors at the University Clinic of Münster. In 1996, he was awarded the Hans-Creutzig-Preis of the Northrhine-Westfalian Society of Nuclear Medicine for his work conducted on the value of radiolabeled amino acids for differential diagnosis between glioma recurrence and radionecrosis. From 1998 until 1999, he headed the Institute of Nuclear Medicine, Biophysics and Radiopharmacy at the Heart and Diabetes Center in Bad Oeynhausen and was Chair of Nuclear Medicine at the Ruhr-University of Bochum.

Since 1999, he has been Chair of Clinical Nuclear Medicine and Director of the Clinic of Nuclear Medicine at the Friedrich-Alexander-University of Erlangen-Nürnberg.

Torsten Kuwert is primarily interested in molecular imaging and has broad scientific expertise in this field. His work is documented in roughly 80 original papers. In Erlangen, he established a Laboratory of Molecular Imaging within the Clinic of Nuclear Medicine allowing the development and validation of new radiopharmaceuticals. He set up a PET center including a dedicated PET camera with – in cooperation

with the PETNET GmbH - a facility for automated and GMP-conforming synthesis of F-18-labeled new PET tracers. Under his guidance the Clinic of Nuclear Medicine entertains several cooperative research projects with Siemens Medical Solutions, the latest of which was highlighted by the Europe-wide first installation of a SPECT/ spiral-CT hybrid camera in the Clinic of Nuclear Medicine in Erlangen in March 2005. Recent research work of Torsten Kuwert deals with correlative imaging in oncology and the development of dopaminergic radioligands and of oncotropic peptides radiolabeled by F-18 using novel strategies.

He is associate editor of Nuklearmedizin and speaker of the radiopharmaceutical committee of the German Society of Nuclear Medicine.

[10:00 – 10:30] Break

[10:30 – 11:15] C3: The Application of Imaging in CNS Drug Development – 45 min

Mark Schmidt, MD
Director, Neuroscience Imaging Unit
Biomarker Development
Novartis Pharma AG

Dr. Mark Schmidt directs neuroscience imaging for the Clinical Imaging Unit in Biomarker Development of Novartis Pharma AG. Dr. Schmidt received his medical degree from the University of Chicago in 1983 and then entered postgraduate training in psychiatry and military service in the US Navy. Following this, Dr. Schmidt was accepted as a Research Fellow in the National Institute of Mental Health (NIMH) Intramural Research Program in Bethesda, Maryland. While at the NIMH he worked in the Section on Clinical Psychopharmacology and assisted in the development of a number of methods for evaluating the pharmacodynamic effects of alpha-2 antagonists including functional imaging with FDG PET. Following this fellowship Dr. Schmidt worked for Lilly Research Laboratories on early and full clinical development studies of antidepressant and anxiolytic compounds. In support of these studies, he directed and assisted in the design of imaging studies including magnetic resonance spectroscopy, dynamic susceptibility contrast MRI, FDG PET, receptor specific tracers, and the identification of candidates for new receptor specific tracers for the serotonergic and glutamatergic systems. Since joining Novartis, he has continued to help with the design of imaging strategies for early clinical development of neuroscience compounds and evaluation of new methods of functional imaging including beta-amyloid targeting radioligands, PET ligands for the metabotropic glutamate subtype 5 receptor, and defining tissue specific kinetics of small molecules and biological products using PET. Dr. Schmidt is a member of the industry steering committee and the PET working group for the Alzheimer's Disease Neuroimaging Initiative.

[11:15 – 12:00] C4: Panel Discussion – 45 min

Panel Members include:

Cor Loef [Philips Medical Systems], WG-10 Co-chair
Joel Chabriais, MD [Societe Francaise de Radiologie], WG-10 Co-chair
Sebastian Schmidt, MD
Torsten Kuwert, MD
Mark Schmidt, MD

[12:00 – 13:00] Lunch – 1 hr.

Conference Ends

WG-10 (Strategic Advisory) Meets [13:15 – 17:30]

Ballroom A & B

All are welcome to attend.