



## STRATEGIC DOCUMENT

Last revised: 2014-10-31

The purpose of this document is to provide a summary of the current activities and future directions of the DICOM Standard. The content of the document is largely based on information submitted by individual working group chairs. The date of the last change of the strategy is marked for each working group; changes to the listing of Secretaries and/or Co-Chairs are made as needed.

### Contents

<u>INTRODUCTION</u>	
<u>The DICOM Standards Committee</u>	
<a href="#"><u>WG-01: Cardiac and Vascular Information</u></a>	<a href="#"><u>WG-16: Magnetic Resonance</u></a>
<a href="#"><u>WG-02: Projection Radiography and Angiography</u></a>	<a href="#"><u>WG-17: 3D</u></a>
<a href="#"><u>WG-03: Nuclear Medicine</u></a>	<a href="#"><u>WG-18: Clinical Trials and Education</u></a>
<a href="#"><u>WG-04: Compression</u></a>	<a href="#"><u>WG-19: Dermatologic Standards</u></a>
<a href="#"><u>WG-05: Exchange Media</u></a>	<a href="#"><u>WG-20: Integration of Imaging and Information Systems</u></a>
<a href="#"><u>WG-06: Base Standard</u></a>	<a href="#"><u>WG-21: Computed Tomography</u></a>
<a href="#"><u>WG-07: Radiotherapy</u></a>	<a href="#"><u>WG-22: Dentistry</u></a>
<a href="#"><u>WG-08: Structured Reporting</u></a>	<a href="#"><u>WG-23: Application Hosting</u></a>
<a href="#"><u>WG-09: Ophthalmology</u></a>	<a href="#"><u>WG-24: Surgery</u></a>
<a href="#"><u>WG-10: Strategic Advisory</u></a>	<a href="#"><u>WG-25: Veterinary Medicine</u></a>
<a href="#"><u>WG-11: Display Function Standard</u></a>	<a href="#"><u>WG-26: Pathology</u></a>
<a href="#"><u>WG-12: Ultrasound</u></a>	<a href="#"><u>WG-27: Web Technology for DICOM</u></a>
<a href="#"><u>WG-13: Visible Light</u></a>	<a href="#"><u>WG-28: Physics</u></a>
<a href="#"><u>WG-14: Security</u></a>	<a href="#"><u>WG-29: Education, Communication and Outreach</u></a>
<a href="#"><u>WG-15: Digital Mammography and CAD</u></a>	<a href="#"><u>WG-30: Small Animal Imaging</u></a>

## INTRODUCTION

Last substantive update: 2010-06-16

### A Brief Background of the DICOM Standard

The introduction of digital medical image sources in the 1970's and the use of computers in processing these images after their acquisition led the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA) to form a joint committee in order to create a standard method for the transmission of medical images and their associated information. This committee, formed in 1983, published in 1985 the ACR-NEMA Standards Publication No. 300-1985. Prior to this, most devices stored images in a proprietary format and transferred files of these proprietary formats over a network or on removable media in order to perform image communication. While the initial versions of the ACR-NEMA effort (version 2.0 was published in 1988) created standardized terminology, an information structure, and unsanctioned file encoding, most of the promise of a standard method of communicating digital image information was not realized until the release of version 3.0 of the Standard in 1993. The release of version 3.0 saw a name change, to Digital Imaging and Communications in Medicine (DICOM), and numerous enhancements that delivered on the promise of standardized communications.

The DICOM Standard now specified a network protocol utilizing TCP/IP, defined the operation of Service Classes beyond the simple transfer of data, and created a mechanism for uniquely identifying Information Objects as they

are acted upon across the network. DICOM was also structured as a multi-part document in order to facilitate extension of the Standard. Additionally, DICOM defined Information Objects not only for images but also for patients, studies, reports, and other data groupings. With the enhancements made in DICOM (Version 3.0), the Standard was now ready to deliver on its promise not only of permitting the transfer of medical images in a multi-vendor environment, but also facilitating the development and expansion of picture archiving and communication systems (PACS) and interfacing with medical information systems.

## **Scope of DICOM**

The DICOM Standards Committee exists to create and maintain international standards for communication of biomedical diagnostic and therapeutic information in disciplines that use digital images and associated data. The goals of DICOM are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in healthcare environments worldwide. DICOM is a cooperative standard. Connectivity works because vendors cooperate in testing via either scheduled public demonstrations, over the Internet, or during private test sessions. Every major diagnostic medical imaging vendor in the world has incorporated the Standard into its product design, and most are actively participating in the enhancement of the Standard. Most of the professional societies throughout the world have supported and are participating in the enhancement of the Standard as well.

DICOM is used or will soon be used by virtually every medical profession that utilizes images within the healthcare industry. These include cardiology, dentistry, endoscopy, mammography, ophthalmology, orthopedics, pathology, pediatrics, radiation therapy, radiology, surgery, etc. DICOM is even used in veterinary medical imaging applications. DICOM also addresses the integration of information produced by these various specialty applications in the patient's Electronic Health Record (EHR). It defines the network and media interchange services allowing storage and access to these DICOM objects for EHR systems.

## **Technology Overview**

The DICOM Standard addresses multiple levels of the ISO OSI network model and provides support for the exchange of information on interchange media. DICOM currently defines an upper layer protocol (ULP) that is used over TCP/IP (independent of the physical network), messages, services, information objects and an association negotiation mechanism. These definitions ensure that any two implementations of a compatible set of services and information objects can effectively communicate.

Independence from the underlying network technology allows DICOM to be deployed in many functional areas of application, including but not limited to communication within a single site (often using various forms of Ethernet), between sites over leased lines or virtual private networks (VPNs), within a metropolitan area (often using Asynchronous Transfer Mode), across dial-up or other remote access connections (such as by modem, ISDN or DSL), and via satellite (with optimized protocol stacks to account for increased latency).

At the application layer, the services and information objects address five primary areas of functionality:

- Transmission and persistence of complete objects (such as images, waveforms and documents),
- Query and retrieval of such objects,
- Performance of specific actions (such as printing images on film),
- Workflow management (support of work lists and status information) and
- Quality and consistency of image appearance (both for display and print).

DICOM does not define architecture for an entire system; nor does it specify functional requirements, beyond the behavior defined for specific services. For example, storage of image objects is defined in terms of what information must be transmitted and retained, not how images are displayed or annotated. An additional DICOM service is available to specify how the image must be presented with annotations to the user. DICOM can be considered as a standard for communication across the "boundaries" between heterogeneous or disparate applications, devices and systems.

The services and objects that are defined in DICOM are designed to address specific, real-world applications (such as the performance of an imaging study on an acquisition device). As such, DICOM is not a general-purpose tool for distributed object management. In general, information is transferred "in bulk" according to a "document" paradigm.

By contrast, general-purpose standards for distributed object or database management generally provide lower level, more atomic access to individual attributes. Though the DICOM Standard does provide the so-called “normalized” services for patient and study management, these have not proven popular, and the “composite”, document-oriented, services have prevailed. This is most likely a consequence of the natural division of functionality between different vendors, devices and applications. For example, the ability to “set” or “change” a patient’s name is generally implemented in a proprietary and centralized manner. To safely distribute responsibility for such a change across boundaries between different applications requires more underlying support than DICOM currently possesses (such as support for transactions and two-phase commitment).

At the present time, the pressing needs in DICOM (as indicated by the priorities of the various working groups) are to address issues relating to new modality technology, structured and coded documents for specific clinical domains, workflow management, security and performance. These needs are being successfully addressed using the conventional “underlying” DICOM technology. Where there are interfaces to standards based on other technologies (such as HL7 V2.x and 3), the focus for harmonization is on a shared “information model.” It may be the case that the nature of the underlying technology needs to be revisited in the future, whether it is to make use of more sophisticated off-the-shelf distributed messaging tools such as Web Services, or ubiquitously used encoding tools such as XML. However, the current priority is to address improvements in functionality to better meet the needs of the end-user, rather than to adopt an alternative encoding and distribution technology for the sake of it. This priority is continually reinforced by a desire to remain compatible with the installed base of equipment.

When specific new technology is required, e.g., in support of new features such as security and compression, the strategy is to adopt proven international, industry or de facto standards. Accordingly, network confidentiality and peer authentication in DICOM are provided by the use of either TLS (an Internet standard) or ISCL (an ISO-based standard). Similarly, rather than develop medical-image-specific compression schemes; DICOM adopts standards developed by ISO/IEC JTC 1/SC 29/WG 1 such as JPEG and JPEG 2000. For interchange media, standard file systems compatible with conventional software (such as ISO 9660 and UDF) are used.

### **DICOM’s Relationship to Other Standards**

Throughout the development of DICOM, much attention was devoted to establishing working relationships with related standards initiatives throughout the world. The initial version of the Standard leveraged prior work by ASTM. The Internet protocol TCP/IP was adopted in 1993. In the nineties, solid cooperation with CEN, the European Committee for Standardization, resulted in a number of jointly developed supplements. CEN has created and approved a normative reference to the DICOM Standard in EN 12052, an official European Norm. In parallel, the convergence of a Japanese interchange media format (IS&C) with DICOM required much joint work where JIRA, the Japan Industries Association of Radiological Systems, played a major role. In the USA, DICOM participated in the early coordination efforts for healthcare standards with the ANSI-HISB from which DICOM adopted a harmonized patient name structure, and started progressively to define links with HL7. This cooperation has now entered in a very active phase with the creation, in 1999, of a joint DICOM-HL7 working group. DICOM established a Type A liaison with the ISO Technical Committee 215 at its creation in 1999. ISO TC 215 has decided not to create an imaging working group, but to rely on DICOM for bio-medical imaging standards. In 2006, ISO approved DICOM as an ISO reference standard (#12052), as CEN has done. In 2003, the DICOM Standards Committee became a member of the e-Health Standardization Coordination Group, a group endorsed by the ITU with the objective to promote a stronger coordination amongst the key players in the e-Health Standardization area. Additionally, in 2005, DICOM accepted a position on the Board of Directors of ANSI’s Healthcare Information Technology Standards Panel and on the Healthcare Technology Task Force of the World Standards Cooperation.

DICOM is also focusing its attention to the evolution of standards linked to the Internet. DICOM’s strategy is to integrate Internet Recommendations as soon as they are stable and largely disseminated in consumer commercial products. In this evolution, much care is taken to ensure that the consistency of the DICOM Standard is maintained with its large installed base. DICOM already uses standard healthcare enterprise intranets, the e-mail exchange of DICOM objects (using a Standard MIME type) is possible, and the Web Access to DICOM persistent Objects (WADO) service has been defined in a joint effort with ISO TC215. It is clear that the use of DICOM objects and services in commonly used information technology applications will grow in the future, given the world-wide ambition in healthcare to create Electronic Health Records.

Finally, DICOM has a strong relationship with IHE, the Integrating the Healthcare Enterprise initiative, where profiles of standards are defined as solutions for healthcare workflow and enterprise integration challenges.

## DICOM's Organizational Structure

DICOM is an independent, international standards development organization administered by NEMA's Medical Imaging and Technology Alliance. The complete Procedures (bylaws) of the DICOM Standards Committee are available on the DICOM Web page at <http://dicom.nema.org>. Working groups of the DICOM Committee perform the majority of work on the extension of and corrections to the Standard. Working groups are formed by the DICOM Committee to work on a particular classification of tasks. Once formed, working groups petition the DICOM Committee to approve work items for which the working group will execute the plan delineated in the work item. Once the output of a work item (generally a supplement or correction proposal) has been completed, it is submitted to Base Standards Working Group (WG-06), for their review. Supplements to the Standard then go through a public comment period, after which the DICOM Committee authorizes the supplement for letter ballot by DICOM members. Letter ballots require approval by two-thirds of those voting affirmative or negative and return of more than one-half of the ballots sent to members in good standing relative to letter ballots. Since the working groups perform the majority of work on the extension of and corrections to the Standard, the current status and future directions of the DICOM Standard are best represented by review of each working group.

[Return to Contents](#)

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## The DICOM Standards Committee and Its Working Groups

### The DICOM Standards Committee

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
General Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Co-Chair	John A. Carrino, MD, MPH, American College of Radiology Johns Hopkins School of Medicine <a href="mailto:CarrinoJ@HSS.EDU">CarrinoJ@HSS.EDU</a>
Co-Chair	Harry Solomon, GE Healthcare <a href="mailto:harry.solomon@med.ge.com">harry.solomon@med.ge.com</a>

### Committee Profile

Last strategy update: 2010-06-16

### Scope:

The DICOM Standards Committee exists to create and maintain international standards for communication of bio-medical diagnostic and therapeutic information in disciplines that use digital images and associated data. The goals of DICOM are to achieve compatibility and to improve workflow efficiency between imaging systems and other information systems in healthcare environments worldwide.

[Return to Contents](#)

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### WG-01 (Cardiac and Vascular Information)

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>

Chair

Harry Solomon, GE Healthcare  
[Harry.Solomon@med.ge.com](mailto:Harry.Solomon@med.ge.com)

**WG (Working Group) Profile**  
Last strategy update: 2009-03-27

**Scope:**

To develop standards for the interchange of cardiovascular information.

The Working Group operates in coordination with WG-02 for X-ray angiography imaging, WG-12 for ultrasound imaging, and WG-08 for Structured Reporting.

**Roadmap:**

The cardiology department is a multi-modality mix of many types of equipment from many different manufacturers. Moreover, cardiovascular medicine requires consultation and interaction between many medical disciplines, and treatment of a patient over extended periods of time. Standardized data interchange is critical in this environment.

The WG-01 roadmap has been a long-term strategy to specify information objects and services to fully digitize and integrate data flow within the cardiology department. The ultimate goal is a comprehensive digital cardiovascular record for the patient, of which the DICOM-based cath lab record and other (non-invasive) imaging exams are a significant part.

The WG-01 work effort has produced DICOM data object formats for X-ray angiography (XA) images; cardiovascular waveforms, with specializations for hemodynamics (HD), cardiac electrophysiology (EPS), and electrocardiography (ECG); and intra-vascular ultrasound (IVUS) images. WG-01 has developed templates for DICOM Structured Reporting for measurements and analysis of these images and waveforms, and for observations made in imaging-based exams (such as procedure logs).

**Short Term Goals:**

- Specification of information objects and structured reports for electrophysiology
- Specification of information object for intravascular optical coherence tomography (IVOCT)
- Correction Proposals for the existing Standard in support of cardiology needs

**Current Status:**

WG-01 plans to meet twice per year for 1 day each, plus interim discussions by telephone conference.

**Current Work Items:**

- Cardiac Electrophysiology
- Intravascular Optical Coherence Tomography
- Waveform Presentation State (inactive)

**Risks:**

As the major cardiology information types have been addressed, the remaining work is narrowly focused. With constrained travel budgets for WG participants, it will be a challenge to move the remaining items to conclusion with sufficient overview from both clinical and industry members.

**Challenges and Opportunities:**

The locus of much of the effort toward the digital cardiovascular patient record is now in the IHE Cardiology initiative, which is directed to improving implementation of the Standard and addressing the broader end-to-end workflow integration. WG-01 has actively encouraged the development of the IHE Cardiology initiative, and much of its current work program addresses gaps in the DICOM Standard identified by IHE.

WG-01 will continue to monitor the needs of the cardiology community for further standardization efforts. Areas identified for potential future efforts include pediatric cardiology.

[Return to Contents](#)

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## **WG-02 – Projection Radiography and Angiography**

Secretariat (U.S.) Secretary	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA) Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Secretariat (Europe) Secretary	European Society of Radiology Annalisa Trianni, ESR Universitaria “S. Maria della Misericordia,” Udine, Italy <a href="mailto:trianni.annalisa@aoud.sanita.fvg.it">trianni.annalisa@aoud.sanita.fvg.it</a>
Chair	Francisco Sureda, GE Healthcare <a href="mailto:francisco.sureda@med.ge.com">francisco.sureda@med.ge.com</a>

### **WG (Working Group) Profile** Last strategy update: 2012-12-05

#### **Scope:**

- To develop and maintain the XA-, XRF-, DX-, CR-specific objects for the DICOM standard in the domains of 2D and 3D X-Ray imaging (general radiography, angiography, cardiology, neuro-radiology, radio-fluoroscopy, electrophysiology), technical reports, dose information and clinical information, related to the patient and medical staff of interventional procedures or general X-ray procedures.

#### **Roadmap:**

- The WG-02 roadmap follows a long-term strategy to specify information objects and possibly services to digitize and integrate the data flow within a general Radiography and Angiography laboratory environment.

#### **Short Term Goals:**

- Work on CPs to include changes to XA-IODs (2D and 3D) that are based on existing modules and functional groups from other IODs.
- Collaborate with WG-11 on the Work Item 2008-04-C for Multi-Dimensional Presentation State.
- Work on Supplement 167 for X-Ray 3D Informative Annex.
- Collaborate with WG-07 in the definition of a “trusted” Frame of Reference.
- Ensure consistency between DICOM and IEC specification for Dose Reporting.
- Monitor the IHE Dose Reporting profile and ensure consistency between DICOM and IHE.
- Extend the Dose Reporting to include information for the calculation of skin dose in interventional.
- Collaborate with WG-28 to create a new supplement for Patient Dose SR including skin dose mapping.
- Participate to the WG-06 ad-hoc group to create an Injector Record SR.
- Work on a new supplement for storage and exchange of protocol data in X-Ray Angiography.

#### **Current Status:**

- WG-02 continues to hold quarterly face-to-face meetings and teleconferences between the face-to-face meetings.
- Short-term goals are defined.
- WG-02 is involved in the IEC PT 61910-1 to create an international standard for dose reporting.

- WG-02 holds joint meetings with WG-28 to define the structure of a Patient Dose SR.

#### **Future Work Items:**

- N/a.

#### **Risks:**

- Too many proprietary solutions are already in use.
- If clinical users and vendors do not participate, the results may not meet all user requirements or may not be broadly accepted.

#### **Challenges and Opportunities:**

- Encourage clinical users and vendors to participate in finding solutions.
- In the general Radiography and Angiography lab environment already various non-image data exist and need to be exchanged to assure flow of information. The different departments are increasingly switching to digital communication and rely on implementation of Standards.
- The increasing complexity of angiographic presentation applications requires storing these presentation properties persistently outside of the image objects.

[Return to Contents](#)

#### **WG-03 (Nuclear Medicine)**

Secretariat  
Secretary

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[SVastagh@medicalimaging.org](mailto:SVastagh@medicalimaging.org)

DICOM Assistant

Luiza Kowalczyk  
[lkowalczyk@medicalimaging.org](mailto:lkowalczyk@medicalimaging.org)

Chair

Jeff Pohlhammer, Philips Healthcare  
[jeff.pohlhammer@philips.com](mailto:jeff.pohlhammer@philips.com)

**WG (Working Group) Profile**  
Last strategy update: 2012-04-10

#### **Scope:**

To develop standards for the digital interchange of Nuclear Medicine and PET images.

#### **Roadmap:**

There are currently two approved work items for WG-03. These are 1) Creation of a dose reporting structure suitable for reporting patient dose due to a general NM (planar or SPECT NM) or PET scan, and, 2) Creation of a new Enhanced NM IOD based on the architecture of the other new Enhanced IODs such as CT, MR, PET, etc.

Likewise, the group will monitor acceptance and success of the new Enhanced PET IOD, and will develop CPs to address any problems with the PET IOD as they arise.

Working Group 3 has worked very closely with other professional organizations, such as the Society of Nuclear Medicine, American Society of Nuclear Cardiology, IHE, etc., to help promote acceptance of DICOM in NM, and ensure that the standard supports the need of the NM community.

**Current Status:**

- Work continues on the two work items described above. The Dose report has completed a first reading with Working Group 6. It has now been assigned supplement number 159.
- Completed development of Supplement 117, the new Enhanced PET IOD. This supplement defines a new multi-frame PET IOD consistent with the other new Enhanced IODs (MR, CT, etc.). The group will monitor acceptance and success of the new Enhanced PET IOD, and will develop CPs to address any problems with the IOD as they arise.
- Completed work on CP666, a joint effort with members from other Working Groups. This CP unifies support for cardiac and respiratory gating among all of the new Enhanced IODs, and expands the scope of the support to include prospective and retrospective techniques, multiple methods for specifying the portions of the cardiac or respiratory cycles to be imaged, acquisition of data over multiple cycles, and for dividing the cardiac or respiratory cycles into multiple time segments. Combination of simultaneous cardiac and respiratory gating is also supported.

**Short-Term Objectives:**

- Much progress has been made on Supplement 159. A working meeting is in the process of being set up for Tuesday, June 12, 2012, in Miami (during Society of Nuclear Medicine annual meeting).
- There has been some discussion about the structure of the Enhanced NM IOD. Future meetings will include work on this item.
- While CP666 goes a long way in adding support for many new gating features in all of the enhanced IODs, there are still a few details that remain to be addressed. WG3 must begin discussion of possible CPs to address these. This will likely not be possible until adoption of the Enhanced PET IOD begins.

**Current Work Items:**

- 1) Create new Dose Reporting structure for reporting patient dose related to PET and general NM scans (Sup159).
- 2) Create new Enhanced NM IOD.

**Risks:**

None.

**Challenges and Opportunities:**

- The older single frame PET, CT and MR IODs, and the NM IOD (which is already multi-frame) are widely supported within the imaging industry. Adoption of the new Enhanced IODs will depend on identification of clear benefits over continued use of these older IODs.
- Gating support is one of these clear advantages for the Enhanced IODs, since the older IODs (especially CT and MR) do not support cardiac gating well, and do not support respiratory gating at all. For PET, which is almost exclusively part of a hybrid system, and NM, which is increasingly also part of a hybrid system, in which PET or NM is paired with another modality; there is a clear advantage to using IODs with similar architecture.
- Working Group 3 can work with other organizations such as InfoRad, to help promote adoption of the new Enhanced PET and NM IODs.

[Return to Contents](#)

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**WG-04 (Compression)**

Secretariat  
Secretary

DICOM Assistant

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[svastagh@medicalimaging.org](mailto:svastagh@medicalimaging.org)  
Luiza Kowalczyk  
[lkowalczyk@medicalimaging.org](mailto:lkowalczyk@medicalimaging.org)



Chair

Alan Rowberg, MD, University of Washington (ACR)  
[arowberg@earthlink.net](mailto:arowberg@earthlink.net)

**WG (Working Group) Profile**  
Last strategy update: 2007-11-29

**Scope:**

To provide data compression facilities for the DICOM standard and to advise on application or object-related definitions of data compression parts of the DICOM Standard created by other working groups.

**Roadmap:**

Develop appropriate DICOM transfer syntaxes for new Parts of JPEG 2000 as they are released.

**Short-Term Objectives:**

We plan to serve a maximal number of modalities and clinical situations, with support for growing areas such as telemedicine.

**Current Status:**

Compression that is already available in the standard:

- JPEG (ISO 10918-1) - all processes
  - lossy (DCT)
  - lossless
  - sequential, progressive
  - Huffman, arithmetic entropy coders
- RLE (aka TIFF Packbits)
  - ultrasound
- JPEG-LS (ISO 14495-1) (DICOM CP-174)
  - lossless, lossy (“near-lossless”)
- JPEG 2000 Part 1 (ISO 15444-1)
- JPEG 2000 Part 2 Multi-Component Transfer Syntaxes
- JPEG 2000 JPEG Interactive Protocol (JPIP)

**Current Work Items:**

None currently, but we are starting to prepare a work item for 3D image compression. We hope to start an educational effort related to compression in medical imaging in the next year.

**Challenges and Opportunities:**

Both the user and vendor communities have an investment in current technology and may be slow in embracing new compression techniques. The issues surrounding the use of irreversible (lossy) compression in clinical environments have also been a limiting factor.

**Relationships to Other Standards:**

DICOM has cross-representation to JPEG 2000.

[Return to Contents](#)

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**WG-05 (Exchange Media)**

Secretariat

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)

Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	David Clunie, MBBS, PixelMed Publishing <a href="mailto:dclunie@dclunie.com">dclunie@dclunie.com</a>

**WG (Working Group) Profile**  
Last strategy update: 2012-11-12

**Scope:**

To develop DICOM standards for interchange media.

**Roadmap:**

- Continue to evaluate new media types that are potentially suitable as they become available.
- Address workflow issues related to media creation.
- Address workflow issues related to media importation to the PACS (in conjunction with IHE).

**Short-Term Objectives:**

- Address any issues arising out of the use of IHE Portable Data for Imaging (PDI) profile.
- Address any issues arising out of the use of IHE Import Reconciliation Workflow (IRW) profile.

**Current Status:**

- None.

**Current Work Items:**

- None

**Risks:**

- Physical media is growing obsolete and being replaced by network-based alternatives.

**Challenges and Opportunities:**

- Leverage the popularity of consumer media formats.
- Avoid proliferation of excessive numbers of alternative media and profiles.
- Optimize media related workflow.

**Relationships to Other Standards:**

An “informal” liaison with OSTA exists to harmonize efforts with respect to UDF, MOD and DVD, though no interaction has taken place with this group since UDF 2.0 was standardized.

[Return to Contents](#)

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**WG-06 (Base Standard)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	Bas Revet, Philips Healthcare

**WG (Working Group) Profile**  
Last strategy update: 2011-11-18

**Scope:**

WG-06 maintains the overall consistency of the DICOM standard. Some of the responsibilities include:

- Execution of the DICOM Maintenance Process (Correction Proposals). The process is used to make “corrections and minor changes” to the current versions of the Standard.
- Provision of technical coordination and guidance for all WGs. This includes review and official approval before the Public Comment, Letter Ballot, and Final Text releases of all supplements.
- Development of Supplements to the standard related to Print, Image Management, etc.
- Coordination of joint development efforts with CEN, JIRA, ISO, and Medis DC.
- Coordination with NEMA for the publication of DICOM.

**Roadmap:**

On-going DICOM Maintenance Process:

- Correction Proposals submitted by the members and other interested parties will continue to be considered by the WG-06
  - All Correction Proposals accepted by WG-06 and designated for inclusion into voting package, will be published on the FTP server for the comments by all DICOM Committee members at least 2 weeks before the WG-06 meeting considering such voting package for Letter Ballot
- A regular CP telecon one week before the face to face meeting is now part of the WG-06 meeting process. This teleconferencing for CP processing has been successful for reducing the time needed for CPs in the face to face meetings by about 2 hours. Roughly half of the CPs are handled in the teleconference with only the final approval vote for confirmation at the face to face meeting. The others require face to face discussion.

Potential work items of other Working Groups:

- WG-06 will provide assistance to the working groups working on their assigned work items.
- All work items (as supplements to DICOM Standard) approved by DSC and prepared by corresponding working groups will be accepted for review by WG-06 and for preparation of Letter Ballot.
- All Supplements approved by the Letter Ballot will be considered in order to prepare Final Text, with addressing of any comments received.

There is a proposed new work item to provide a change management SOP class or classes, as well as normative behavioral text to support the long term management of DICOM objects.

There is an approved new work item to define a Multi-frame Converted Legacy Image SOP Class to allow the fast transfer of series of images in a multi-frame SOP Instance instead of individual single images. This prevents delays by waiting for response message for each individual image.

**Short Term Goals:**

- Develop mechanisms for publication of DICOM standard in XML. The most recent effort using DocBook as the source format is promising.
- There is a proposal to issue the next official version of DICOM in just an HTML format, due to the complexity of generating the PDF form (with consistent pagination, illustration placement, cross references, etc.) from the DocBook form. The generation of high quality HTML format (similar to the W3C standard format) is much simpler. The proposal is to try this to determine whether the additional effort needed for PDF format is worthwhile. Feedback from the DICOM committee is requested.

**Completed Work Items:**

- Supplement 96 – Unified Performed Procedure Step

**Current Work Items:**

- Supplement 115 – Evidence Document
- Supplement 121 – Modality Procedure Plan and Protocol Storage
- Whitepapers on change management and long term consistency are in preparation. These will lead to new work item proposals.
- Whitepaper to describe joint approach between DICOM and IHE Radiology for defining the application profiles that describe the usage of DICOM definition for a particular clinical use case.

**Risks:**

Workload is decreasing due to the limited number of supplements in progress. But a number of supplements in progress need substantial support from WG-06 due the introduction of new and complex functionality or inexperienced editors.

**Challenges and Opportunities:**

We have gained several regular new members contributing to WG-06. This will increase our review capacity, although it does not increase the practical meeting hours available.

**Relationships to other Standards:**

WG-06 functions as conduit for joint work with ISO TC215.  
Progress of the IHE initiative is being regularly reviewed by WG-06.

[Return to Contents](#)

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**WG-07 (Radiotherapy)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	Ulrich Busch, Varian Medical Systems <a href="mailto:Ulrich.Busch@varian.com">Ulrich.Busch@varian.com</a>
Vice-Chair	Christof Schadt, Brainlab AG <a href="mailto:Christof.Schadt@Brainlab.com">Christof.Schadt@Brainlab.com</a>

**WG (Working Group) Profile**

Date of Last Update: 2013-12-03

**Scope:**

WG-07 develops and maintains the radiotherapy objects and related functionality in the DICOM Standard, and supports and promotes its adoption by industry and community.

Some of the responsibilities include:

- Developing objects for various treatment modalities  
(External Beam, Brachytherapy, Ion Therapy, Robotic Treatment Devices, Cobalt etc.)

- Taking care, that Imaging is well-integrated into the Radiotherapy Process
- Ensure, that geometric concepts (frame of reference and related constructs) are well-defined so that radio-therapeutic planning and delivery can rely on precise geometric definitions to ensure safe beam placement
- Considering and further developing DICOM Unified Worklist concepts and specifications and make use of those approaches in to the Radiotherapy workflow

### **Roadmap:**

The major goal of WG-07 is to enable departmental workflow, improve safety through tighter standard definition, and open DICOM to new technologies and processes in RT. Those goals are closely related to activities of IHE-RO, where profiles are in development to support the same goals.

WG-07 and IHE-RO directions are well-aligned which each other and the clinical community, and there is a close relationship to IHE-RO (for many individuals on a shared membership basis). Further on professional societies (most prominently ASTRO and AAPM) are asking for more electronic process control and safety checks, which require a powerful workflow environment. WG-07 is committed to serve those interests in the area of interoperability it deals with.

The current and future processes in radiotherapy have considerable evolved since the introduction of Radiotherapy object to DICOM in 1997. Further on, new treatment modalities and positioning techniques seek support for interoperability. This led WG-07 to the conclusion, that the current ('1<sup>st</sup> Generation') DICOM object for RT are at their limits and a new generation of DICOM Radiotherapy objects is needed.

Therefore the roadmap of WG-07 for the next years focusses of the introduction of the so-called '2<sup>nd</sup> Generation Radiotherapy objects' to the DICOM standard.

Specifically the following areas are in focus of WG-07 throughout the next years:

- Supplement 147 (Second Generation Radiotherapy)
  - That supplement is the foundation for 2<sup>nd</sup> Generation Radiotherapy objects, and adds already various treatment modalities to the Standard
  - WG-07 concentrates to get this supplement finished first, followed by some other small supplements which will then incrementally add other objects (e.g. Ions and Brachytherapy) to that foundation.
- Supplement 160 (Patient Positioning and Workflow)
  - This supplement covers the workflow of a Radiotherapy Treatment Session across components of different vendors being involved in preparation, patient positioning, treatment delivery and post-treatment review activities.
  - This supplement makes use of the concepts and definitions in Supplement 147, but maybe used in parts already the context of 1<sup>st</sup> generation Radiotherapy objects.
  - The supplement is closely related to IHE-RO Profiles (especially the workflow-related profiles)
- Ion Therapy
  - Maintenance of 1st Generation as needed prior to 2<sup>nd</sup> Generation RT Objects
  - Introduction of Ion therapy object to 2<sup>nd</sup> Generation along the concepts of Supplement 147
- Brachytherapy
  - Maintenance of 1st Generation as needed prior to 2<sup>nd</sup> Generation RT Objects
  - Introduction of Brachytherapy therapy object to 2<sup>nd</sup> Generation along the concepts of Supplement 147
- New Development
  - Companion objects for Treatment Planning, Dose etc.
  - Approaches to represent local data clusters, which reference all objects relevant to a specific use case.
  - New Services to improve efficiency and specificity of retrieving data
  - Reports specific to segmentation and radiotherapy use cases

### **Short Term Goals:**

WG-07 is working to finalize Supplement 147 (Second Generation Radiotherapy) for public comment. The public comment phase is expected to start in 2014, lasting 6 month.

Work of Supplement 160 should be resumed in conjunction with the IHE-RO Technical Committee subgroup for the DPDW (Discrete Positioning and Delivery Workflow) Profile.

The Brachytherapy and Ion Subgroups will continue to work actively on the agenda described above.

**Current Status:**

Supplement 147 (Second Generation Radiotherapy) is near to completion to be presented to a wider audience in public comment.

Supplement 160 is available in an initial version and work is ongoing.

WG-07 has established 2 subgroups dealing with the specific treatment techniques of Ion Therapy and Brachytherapy. Those subgroups will contribute the 2<sup>nd</sup> Generation object definitions, but also will take care of some 1<sup>st</sup> Generation Standard maintenance as needed.

**Completed Work Items (since beginning):**

- Supplement 11 (RT Image, RT Structure Set, RT Dose, RT Plan)
- Supplement 29 (RT Treatment Record Objects and Media Support)
- Supplement 102 (Ion Therapy) is part of the DICOM 2006 standard.
- Supplements 74 (Utilization of Worklist in Radiotherapy Treatment Delivery) in connection with WG-06-sponsored Supp 96 (Unified Worklist and Procedure Step)

**Current Work Items:**

- Supplement 147 (Second Generation Radiotherapy), being developed pursuant to work item 2007-06-B.
- Supplement 160 (Patient Positioning and Workflow), being developed pursuant to work item 2011-12-A.

**Risks:**

The agenda of WG-07 has a considerable broad scope. Resources working in Radiotherapy and being DICOM literate are not abundant and are shared with IHE-RO Technical Committee activities.

While important for safe and efficient interoperability in modern radiotherapy, the adoption of second generation will require a certain amount of training and implementation by the vendors and community. WG-07 will have to play a key role in that process.

IHE-RO (IHE in Radiation Oncology) is an active initiative requiring support from DICOM for workflow and other activities. WG-07 needs to progress its work at a rate consistent with IHE-RO goals where possible.

**Challenges and Opportunities:**

Adoption of upcoming second-generation radiotherapy objects represents significant investment by manufacturers. The introduction of electronic workflow (predominantly using Unified Worklist and Procedure Step) is an established goal, but also includes with some challenges in respect to coverage and quality of implementation. Although IHE-RO is also promoting their uptake, synchronization of implementations across the industry represents a challenge. The potential payoff is however high: many existing technologies require the new objects, and workflow implementation across the industry could lead to very significant gains in productivity. Recent radiation safety initiatives will also encourage use of Supplement 147 objects and the follow-up supplement to address some of these concerns. Last not least modern radiotherapy cannot be efficiently handled with the 1<sup>st</sup> generation objects anymore, and current implementations increasingly use Band-Aids to support today's workflows.

**Relationships to Other Standards:**

RT objects make use of IEC-61217 for some certain classes of treatment machines, where C-Arm isocentric geometry is suited. ICRU concepts for dosimetry as also referred to. IEC/TR 62266 ("Medical Electrical Equipment - Guidelines for Implementation of DICOM in Radiotherapy"), and IEC 62274 ("Safety of Radiotherapy Record and Verify Systems") have also been published. IEC has started to recognize DICOM as a mean of electronic data transfer, and WG-07 will continue to be involved in review of IEC standards where necessary, especially where IEC Standards could eventually have overlapping definitions on electronic data representations which are covered by DICOM already.

In the scope of IHE-RO and IHE in general, the boundaries between DICOM and HL7 will be increasingly a topic of consideration while developing the new set of objects. WG-07 will assist in the process to identify the appropriateness of protocols (esp. DICOM versus HL7) for the various use cases.

Proceedings in the definition of Patient Dose Recording Regulations will be monitored by WG-07 for the imaging procedures in the context of radiotherapy treatment delivery.

[Return to Contents](#)

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### **WG-08 (Structured Reporting)**

Secretariat	RSNA
Secretary	Chris Carr, RSNA <a href="mailto:carr@rsna.org">carr@rsna.org</a>
Co-Chair	Charles Kahn, Medical College of Wisconsin / ACR <a href="mailto:kahn@mcw.edu">kahn@mcw.edu</a>
Co-Chair	Harry Solomon, GE Healthcare <a href="mailto:Harry.Solomon@med.ge.com">Harry.Solomon@med.ge.com</a>

### **WG (Working Group) Profile** Last strategy update: 2011-11-18

#### **Scope:**

To develop and maintain the DICOM Structured Reporting specification, and to collaborate with DICOM working groups and other standards development committees in the development of specialized reports and other documents based on the generic SR specification.

#### **Short-Term Objectives:**

- Create a set of guidelines for template creators.
- Support the creation of general, reusable templates components and outlines.
- Maintain the SR infrastructure.
- Create cross-specialty SR templates.
- Develop a methodology (with a standardized graphical notation) to describe templates.
- Assist WG-20 in the integration of DICOM SR with other standards efforts, in particular HL7, and support SR development in the various DICOM WGs.
- Provide technical support for demonstration of SR as required by IHE, MITA, etc.
- Develop a process for submitting clinical use cases and requirements for SR templates.
- Develop a means of specifying SR presentation.
- Develop a formal syntax for encoding the definition of templates and context groups in efforts to facilitate creation of a machine-readable version of these parts of the Standard.

#### **Current Status:**

Working Group Eight meets quarterly. The meetings usually take place at the Radiological Society of North America (RSNA) in Oak Brook, Illinois.

Additional telephone conferences are scheduled as necessary.

## Current Work Items:

WG-08 is currently developing Supplement 155, which will formalize the standard for reporting templates, such as those being developed by the RSNA Reporting Subcommittee. These templates differ from current DICOM Structured Reporting (“DICOM SR”) in that they are intended to specify report content to be “filled in” by the reporting radiologist. Supplement 155 also will define the transformation of completed reporting templates into HL7 Clinical Document Architecture (CDA) documents.

## Risks:

Since the assignment of Clinical Codes to DICOM SR Documents is an essential part of the development process of SR related Supplements, the quality of the resulting Supplements as well as the development speed depends on a close co-operation with providers of Coding Schemes used by DICOM SR.

## Challenges and Opportunities:

- Establish co-operations with Coding Scheme providers
- Support WG-20 in the co-operation with HL7 in the field of the Clinical Document Architecture (CDA)

## Relationship to Other Standards:

- HL7
- IHE
- RSNA Reporting Committee
- SNOMED
- LOINC
- UCUM
- ISO-TC215
- CEN-TC251
- ACR

[Return to Contents](#)

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## WG-09 (Ophthalmology)

Secretariat	American Academy of Ophthalmology
Secretary	Flora Lum, AAO <a href="mailto:flum@aao.org">flum@aao.org</a>
Co-Chair	Lloyd Hildebrand MD, Univ. of Oklahoma / AAO <a href="mailto:lloyd-hildebrand@ouhsc.edu">lloyd-hildebrand@ouhsc.edu</a>
Co-Chair	Mark Horton, Indian Health Service, <a href="mailto:Mark.horton@ihs.gov">Mark.horton@ihs.gov</a>
Co-Chair	Yijun (Eugene) Huang, Univ. Of Wisconsin <a href="mailto:yhuang@rc.opth.wisc.edu">yhuang@rc.opth.wisc.edu</a>

**WG (Working Group) Profile**  
Last strategy update: 2014-10-06

## Scope:

To address all issues relating to imaging and reporting of image-based studies in ophthalmic applications.



## Roadmap:

Integration of the Ophthalmic Photography supplement into the Standard has been a major advance for digital ophthalmic devices and applications. Adoption of ophthalmology-relevant objects will be emphasized in eye care environments through education and demonstration projects in collaboration with the ophthalmic users and industry vendors. Coordinated education and demonstration projects for vendors and users will be essential to get broad adoption of the DICOM Standards in eye care. Extensions/refinements to existing objects will be introduced to accommodate new techniques. Most of the modalities in eye care have been addressed; remaining are wavefront and structured reports for various modalities such as retinal nerve fiber layer and optic nerve head analysis will be addressed.

## Short-Term Objectives:

- Final Text Approval of Wide Field Ophthalmic Photography Image Storage SOP Classes Supplement in 2015
- Development of a Strategy to Enhance Utility of Supp 130 Ophthalmic Refractive Measurements Storage and SR SOP Classes Supplement
- Development of an Approach to Color Eye Model of the International Color Consortium Medical Imaging Workgroup
- Increase the Participation and Implementation of Vendors of DICOM Standards in Eye Care

## Current Status:

- Final Text for Ophthalmic Photography Image SOP Classes Supplement
- Final Text for Ophthalmic Tomography Image Storage SOP Class Supplement
- Final Text for Ophthalmic Axial Length Measurements Storage SOP Classes Supplement
- Final Text for Structured Report Template for Reporting of Macular Grid Thickness and Volume
- Final Text for Visual Fields (OPV) Static Perimetry Measurements Storage SOP Class Supplement
- Final Text of Ophthalmic Thickness Map Storage SOP Class Supplement
- Final Text for Corneal Topography Map Storage SOP Class Supplement

## Current Work Items:

- Structured Report Template for Ophthalmic Reporting of Retinal Nerve Fiber Layer and Optic Nerve Head Analysis
- Acceptance and development of Structured Reporting in the DICOM community for evidence documents and diagnostic reports. Also, determining the boundary between the DICOM domain and the enterprise domain for these structured reports and their encoding in DICOM SR and HL7 CDA.
- The rapid development of web-based distribution of healthcare information. Also, the clear positioning of DICOM in this respect.

## Challenges and Opportunities:

Implementation of existing standardized objects in ophthalmic applications and devices is well on its way. While there has been heightened awareness of DICOM in the vendor and user communities, several vendors still do not participate in the standard development process or use the Standard in their products. The requirements of clinical users and government agencies (users and regulators) for interoperability and compliance with the DICOM format will be the leading indicators driving the increased use of DICOM. The identification and communication of this requirement is important.

[Return to Contents](#)

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## WG-10 (Strategic Advisory)

Secretariat  
Secretary

DICOM Assistant

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[svastagh@medicalimaging.org](mailto:svastagh@medicalimaging.org)  
Luiza Kowalczyk

Co-chair	<a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a> Greg Zeller, American Dental Association
Co-chair	<a href="mailto:zellerg@ada.org">zellerg@ada.org</a> Kevin O'Donnell, Toshiba Medical Research Institute
	<a href="mailto:kodonnell@tmriusa.com">kodonnell@tmriusa.com</a>

WG (Working Group) Profile  
Last strategy update: 2011-11-24

### Scope:

To consider issues and opportunities related to the strategic evolution of DICOM; to provide liaison to other standards developing organizations; to review standards and technology in healthcare, biomedical imaging, commerce, telecommunications, and informatics; and to develop and maintain the long-term strategic plan of the DICOM Standards Committee (DSC).

### Roadmap:

- Advise the DSC on the influence of technology evolution on DICOM.
- Coordinate the relationship between DICOM and ISO TC 215.
- Advise the DSC about the relationship and impact on DICOM of actions of the various relevant IHE domains (Integrating the Healthcare Enterprise)
- Explore and advise the DSC about the influence of Web-technology on DICOM. Explore the opportunities for the distribution of DICOM persistent objects into the patient's electronic medical record, accessed inside and outside the healthcare enterprise.

### Objectives: As outlined in the Scope and Roadmap

### Risks:

- The co-operation of DICOM with other standards is becoming an increasingly important point in the endeavor to achieve the overall electronic medical record for the patient; the lack of consensus on which standards to use, makes this a complex process, upon which DICOM has little influence.
- New emerging technologies in Healthcare may give rise to the perception that DICOM is obsolete.
- Large data objects and the number of objects in medical imaging are stretching the capacity (storage, bandwidth) of the infrastructure

### Challenges and Opportunities:

#### Challenges:

### Relationship to Other Standards:

- DICOM has type-A relation to ISO TC215 and cooperates with ISO TC215 on the standards for communication of biomedical diagnostic and therapeutic information in disciplines using digital images and associated data.
- CEN TC251 on Medical Informatics Standards.

[Return to Contents](#)

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### WG-11 (Display Function Standard)

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA
	<a href="mailto:SVastagh@medicalimaging.org">SVastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk
	<a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>

Co-Chair Joe Luszcz, Philips  
[joe.luszcz@philips.com](mailto:joe.luszcz@philips.com)

Co-Chair Vacant

### **WG (Working Group) Profile**

Last strategy update: 2011-12-01

#### **Scope:**

To develop DICOM services related to display and presentation.

#### **Roadmap:**

- Develop Multi-Dimensional Presentation State object(s) in conjunction with DICOM Working Groups 2,4,7,11,12,15,16,17,21,22,24,26; clinical organizations- AAO, AAOMR, ACR, ADA, AIUM, CARS, ESR; several educational institutions and the Web3D Consortium.
- Investigate the possibility of linking Presentation States with Structured Reports.
- Review completed work for consistency of terminology; consider leveraging the current effort to develop a glossary for the Multi-Dimensional Presentation State work item, into informative text.

#### **Short Term Goals:**

- Bring the Communication of Display Parameters Supplement 124 to Final Text in 2012.
- Monitor the progress of DICOM domain-specific Presentation State Storage SOP Classes and Display related items (e.g., Structured Display)
- Maintenance of existing standards – Grayscale Standard Display Function, Grayscale and Color Softcopy Presentation States, Hanging Protocols.

#### **Completed Work:**

- Grayscale Standard Display Function (GSDF), Supplement 28, Part 14 of DICOM 1998.
- Grayscale Softcopy Presentation State Storage (GSPS), Supplement 33, September 1999, incorporated into DICOM 2000.
- Hanging Protocols, Supplement 60, June 2005.
- Color Softcopy Presentation State Storage SOP Classes, Supplement 100, June 2005.
- Extended Presentation States, Supplement 120, March 2010.

#### **Current Work Items:**

- Communication of Display Parameters, Supplement 124 (2004-12-B)
- Multi-dimensional Presentation States, Supplement (2008-04-C)
- Attribute-Based Annotations (2008-09-A)

#### **Risks:**

##### Short Term

- Achieving a unified approach to 3D presentation within DICOM.
- Availability of adequate resources to complete existing work items, in particular Supplement 124 which requires partnered effort from JIRA's WG-04.

##### Long Term

- Requests for future work items will be dependent on the active participation of vendors and clinicians that perceive a need to expand the DICOM Standard in a specific area. Some items may require cooperation from other working groups, and/or a broadening of the scope of the Display working group.

## Challenges and Opportunities:

### Challenges

- Maintaining expertise, champions, vendor and clinical participation.

### Opportunities

- Work with Web3D Consortium and multiple interested working groups to jointly develop Multi-Dimensional Presentation States.

## Relationships to Other Standards:

- GSDF refers to calibration (quality assurance and quality control) guidelines for electronic displays. AAPM Task Group 18 has published its Image Quality guidelines, as well as potential work by IEC group 62B on electronic displays. JIRA is very active in this area as well.
- Color Softcopy Presentation States, and optionally color images, include ICC Profiles.
- The X3D standard (ISO-19775) addresses encoding and rendering of multi-dimensional dataset attributes, pertinent to the Multi-dimensional Presentation States work item.

[Return to Contents](#)

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## WG-12 (Ultrasound)

Secretariat  
Secretary

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[svastagh@medicalimaging.org](mailto:svastagh@medicalimaging.org)

DICOM Assistant

Luiza Kowalczyk  
[lkowalczyk@medicalimaging.org](mailto:lkowalczyk@medicalimaging.org)

Chair

Joe Luszcz, Philips Healthcare  
[joe.luszcz@philips.com](mailto:joe.luszcz@philips.com)

### **WG (Working Group) Profile** Last strategy update: 2011-04-12

### **Scope:**

WG-12's scope is to maintain and extend the DICOM Standard to meet the needs of the ultrasound and echocardiography specialties. This includes aspects of acquisition related workflow, exchange of acquired data consisting of images, 3D/4D data, and physiologic measurements, and other related matters.

### **Roadmap:**

- In conjunction with WG-11, create 3D presentation state IOD(s) addressing, but not being limited to the following clinical needs:
  - Description of how rendered or multi-planar reformatted (MPR) views are obtained from 3D volume datasets (type of processing, viewport position and orientation relative to the volume, crop/slice planes, sculpting masks, etc.
  - Graphical and textual annotations in 3D space
  - Parameters describing usage of the Enhanced Blending and Display Pipeline (including Palette Color Lookup Tables, Opacity Lookup Table, switching parameters, etc.)
  - Blending operations between/among multiple images of the same or different modalities
- Improve exchange of 2DUS data, addressing, but not being limited to the following clinical needs:
  - Per-frame calibration
  - Oblique spatially-related frames
  - Separation of data types like tissue, flow velocity, variance, etc.
  - Use of a media application profile including JPEG 2000 compression

- More appropriate representation of time sequence data (e.g. M-mode, spectral Doppler, and Doppler audio)
- Waveforms distinct from image

This item includes the development of a 2D variant of Enhanced US Image as well as other IOD's for Doppler audio and waveforms and other time-sequenced data.

- Define 3D spatial coordinate references from Structured Reporting instances to spatial regions within referenced 3D volume datasets, and if appropriate, define a template for the exchange 3D-specific measurements in Structured Reporting.
- Create an ultrasound general imaging SR template (thyroid, abdomen, gallbladder, pelvic, etc.)

#### **Short-Term Objectives:**

- In collaboration with WG-11, develop a multi-dimensional presentation state supplement

#### **Current Status:**

- Supplement 43 (3D/4D) achieved Final Text in April, 2009.
- Supplement 78 (Pediatric Echo Structured Reporting) achieved Final Text in March, 2010.
- WG-12 has active relationship with the American Institute of Ultrasound in Medicine.

#### **Risks:**

- Lack of implementations of Supplement 43 that would exercise the new standard.

#### **Challenges and Opportunities:**

- Encourage adoption of Supplement 78 for fetal/pediatric/congenital and adult echo template and Supplement 43 for 3D/4D image exchange
- Potentially large size of 3D/4D data (particularly for Cardiology applications) and development of improved volumetric compression standards

#### **Relationships to Other Standards:**

- IHE, HL7, LOINC and SNOMED terminology

[Return to Contents](#)

### **WG-13 (Visible Light)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Co-Chair	Hideto Yokoi, Kagawa University <a href="mailto:Yokoi@med.kagawa-u.ac.jp">Yokoi@med.kagawa-u.ac.jp</a>
Co-Chair	Karl-Heinz Fleischer, Carl Zeiss Meditec, Inc <a href="mailto:karl-heinz.fleischer@zeiss.com">karl-heinz.fleischer@zeiss.com</a>

#### **WG (Working Group) Profile**

Last strategy update: 2014-10-02

#### **Scope:**

To accompany the adoption of DICOM standards for still and motion Visible Light color images, produced by endoscopes, microscopes, or photographic cameras, and propose new DICOM standards if required, for creation and use.

**Roadmap:**

- To contribute to accelerate the adoption of the DICOM by Visible Light Users and Vendors.
- To enlarge (number of modalities) and enrich (quantity of information) the DICOM VL standard.
- To see if other topics must be specifically addressed around the existing standards (either in the Composite Information Objects – e.g. video compression, or in the Normalized Objects – e.g. Workflow management).
- To accompany the adoption of HD video by the medical arena, and its acceptance by the PACS community.

**Short-Term Objectives:**

- To ascertain the need for the New Work Item on color management in VL applications by focusing on one such application first: endoscopy
- To continue to advise new IHE-Endoscopy domain.

**Current Status:**

- For the April 16, 2012 meeting, WG-13 will receive an evaluation performed by JAHIS members of the potential need for new DICOM module/fields for color management.
- There are indications of some PACS administrators are requiring support of visible light images in order to centralize image management.

**Future Work Items:**

- No new approved work item for the moment.
- The color management could be one new work item.

**Risks:**

- To date the topic of color management has not attracted sufficient interest of vendors and users beyond a region. If only vendors in one region are interested it could result in a standard that is not inclusive of all vendors and users.

**Challenges and Opportunities:**

- The use of VL images is rapidly growing (non/less invasive surgery, advanced diagnosis, surgery monitoring...). All equipment is migrating from analog to digital technology, thanks to consumer multimedia technologies. Targeted modalities are Gastro-Enterology, Laparoscopy, Orthopedics, Ophthalmology, Ear Nose Throat, Gynecology, Bronchoscopes.
- The manufacturers and users are facing to the necessary integration with other equipment and information system, for quality, safety and efficiency objectives.
- The development of HD video contributes to generalize the digitization of the VL images and to make new requirements appearing in the use of images (e.g. creation and integration of small video clips integrated in the patient record), which imply connection of VL equipment to the computerized environment, enabled by DICOM.
- However, for multiple reasons including the patient safety, the nature of application is very different than the radiology one, requiring new architecture and design, having significant impact on the use of DICOM.

**Relationships to Other Standards:**

- MPEG-2, ISO/IEC 13818, 1996
- MPEG-4 AVC, ISO/IEC 14496-10, H.264 ITU

- Blu-ray Disc Association (BDA)

[Return to Contents](#)

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## **WG-14 (Security)**

Secretariat  
Secretary

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[svastagh@medicalimaging.org](mailto:svastagh@medicalimaging.org)

DICOM Assistant

Luiza Kowalczyk  
[lkowalczyk@medicalimaging.org](mailto:lkowalczyk@medicalimaging.org)

Chair

Lawrence Tarbox, PhD, Mallinckrodt Institute of Radiology  
[tarboxl@mir.wustl.edu](mailto:tarboxl@mir.wustl.edu)

### **WG (Working Group) Profile**

Last strategy update: 2007-11-29

### **Scope:**

To develop extensions to DICOM that address the technical details of providing secure information exchange.

### **Roadmap:**

- Cooperate with the SPC and other organizations in identifying and understanding:
  1. Local and governmental regulations dictating the level of security needed;
  2. Areas where security holes exist in DICOM with respect to meeting that level of security in DICOM transactions.
  3. Security standards being developed by others where DICOM should cooperate or that DICOM can leverage.
- Specify the technical means needed to fill those holes:
  1. Utilizing existing standards wherever possible;
  2. Jointly developing standards where appropriate;
  3. Developing DICOM-specific standards only if no appropriate alternative is available.

### **Short-Term Objectives:**

- Address the need to exchange audit-trail information.

### **Current Status:**

- Supplement 31, specifying secure connections for networks, passed letter ballot and was incorporated into the Standard.
- Supplement 41, specifying a general purpose Digital Signature mechanism, passed letter ballot and was incorporated into the Standard.
- Supplement 51, addressing security on interchange media, passed letter ballot and was incorporated into the Standard.
- Supplement 55, describing mechanisms for de-identification with possible re-identification passed letter ballot with comments, which were addressed, and incorporated into the Standard.
- Supplement 95, Audit Trail Messages, exists as a frozen draft for trial use only.
- Supplement 101, Extended Negotiation of User Identity passed letter ballot and was incorporated into the Standard
- Supplement 113, Email Transport passed letter ballot and was incorporated into the Standard. Note that WG-23 only provided suggestions regarding secure transport of e-mail to WG-6; WG-6 was responsible for creating this supplement.

- WG-14 was also consulted on security issues during the creation of Supplement 85, Web Access to DICOM Persistent Objects (WADO), which passed letter ballot and was incorporated into the Standard.

#### **Current Work Items:**

- Audit-trail message exchange work item, which WG-14 is perusing in conjunction with HL7, IHE, SPC, and ASTM.

#### **Risks:**

- The mechanisms utilized become obsolete or broken.
- Mechanisms that are appropriate for one regulatory body are inappropriate for another.

#### **Challenges and Opportunities:**

- Clearly understanding the level of security required by local and governmental regulations.
- Resolving differences between seemingly conflicting regulations from different bodies.
- Specifying mechanisms that are easily incorporated and do not conflict with work done by other bodies.

#### **Relationship to Other Standards:**

- DICOM security mechanisms should be coordinated with mechanisms being developed by other organizations, such as HL7 and ASTM, to create a comprehensive security package for the entire Electronic Patient Record.

[Return to Contents](#)

### **WG-15 (Mammography and CAD)**

Secretariat	American College of Radiology
Secretary	Wil Creech, ACR <a href="mailto:wcreech@acr.org">wcreech@acr.org</a>
Co-Chair	Dr. Judith Wolfman, Northwestern Memorial (ACR) <a href="mailto:jwolfman@nmff.org">jwolfman@nmff.org</a>
Co-Chair	Janet E. Keyes, Hologic, Inc. <a href="mailto:Janet.Keyes@hologic.com">Janet.Keyes@hologic.com</a>

#### **WG (Working Group) Profile** Last strategy update: 2012-11-19

#### **Scope:**

To develop extensions to DICOM to support breast imaging and reporting thereof, including structured reporting of Computer-Aided Detection / Diagnosis (CAD) results.

#### **Roadmap:**

The following are potential work items with respect to Structured Reporting:

- Maintenance of the existing Mammography CAD, Chest CAD, Colon CAD and Breast Imaging structured reports and associated coded terminology, based on the BI-RADS® Atlas.
- Extension of CAD objects to support new modalities and applications, such as CAD for breast tomosynthesis.

The following are potential work items with respect to Image IODs:

- Addition of attributes or modules to describe DX/Mammography quality control and phantom images.



**Risks:**

- Long term: Future extensions to Chest CAD SR are dependent on the clinical input received toward reaching consensus on a subset of chest radiography terminology to use in describing Chest CAD output results, and assignment of codes for that terminology.
- Roadmap: Requests for future work items will be dependent on the active participation of vendors and clinicians that perceive a need to expand the DICOM Standard in a specific area, and support of the Secretariat for those work items. Some items may require cooperation from other working groups.

**Short Term Goals:**

- Continue work with IHE Radiology Mammography subcommittee on Mammography integration profiles.
- Update Breast Imaging Report templates and context groups relative to pending revisions to BI-RADS® Atlas, including MRI Section.
- Maintenance of the Digital Mammography X-Ray Image IOD, Breast Tomosynthesis Image IOD, Mammography CAD SR IOD, Chest CAD SR IOD, Colon CAD SR IOD and Breast Imaging Report and Relevant Patient Information for Breast Imaging templates and context groups.

**Current Status:**

- Meets 2-3 times per year at the ACR in Reston, VA.
- Participation by members of the computer aided detection, digital radiography, and reporting system community, as well as clinical and research radiologists and ACR staff involved in mammography, chest, and abdomen radiography.

**Current Work Items:**

- Supplement 165: Breast Projection X-Ray Image Storage, early draft to WG 6 November 2012.
- IHE Radiology profile proposal for Stereotactic Breast Imaging, submitted October 2012 for 2012-2013.
- Re-evaluate X-Ray Radiation Dose SR templates for sufficient breast projection x-ray dose reporting.

**Challenges and Opportunities:**

- Monitor future developments in breast imaging technologies, and the need to store and exchange resulting images and related information in DICOM.
- Monitor future developments in CAD research, particularly those that make the technology actively interactive with radiologists.

**Relationships to other Standards:**

- Use of American College of Radiology (ACR) BI-RADS® Atlas terminology as the basis of coded terminology for Structured Reporting for Breast Imaging
- Use of the Mammography Quality Control Manual 1999, available from the American College of Radiology (ACR), as a basis of coded terminology for the reporting of mammography image quality characteristics
- Use of the Mammography Quality Standards Act (MQSA) regulations, a federal regulation of the United States government, as a basis of coded terminology for the reporting of mammography image quality characteristics (21 CFR 900)
- American College of Radiology. ACR Standard for the Performance of Pediatric and Adult Chest Radiography. In: Standards. Reston, VA: 2001:95-98
- American College of Radiology. ACR Standard for the Performance of Pediatric and Adult Thoracic Computed Tomography (CT). In: Standards. Reston, VA: 2001:103-107

[Return to Contents](#)

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## **WG-16 (Magnetic Resonance)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	Wim Corbijn van Willenswaard, Philips Healthcare <a href="mailto:wim.corbijn.van.willenswaard@philips.com">wim.corbijn.van.willenswaard@philips.com</a>

### **WG (Working Group) Profile** Last Strategy Update: 2014-03-17

#### **Scope:**

The principles of the Enhanced MR object, developed in the 1999-2003 timeframe, had successive follow up by other modalities. The MR group pursues opportunities for further enhancement in the area of clinical interoperability for MR

#### **Roadmap:**

Currently there are two items that might result in new work-items. Intention is to form two subgroups each responsible for preparing a supplement. These are the Functional MRI area in cooperation with the QIBA group from RSNA. Second is the cooperation with WG24 (Surgery) on the standardization of DTI information which was originally only focusing on Fiber Tracks but is now extending to get full coverage of data needed.

#### **Short-Term Objectives:**

- Create work-items for fMRI and DTI extensions needed
- Make necessary revisions through CPs
- Promote the opportunities and the implementation of the Enhanced MR objects.

#### **Current Status:**

- IHE profile for CT/MR Contrast Perfusion is changed through a CP and tested during last US Connectathon with several different vendors for all actors.
- Enhanced MR Color object has been defined. It is not yet broadly supported in the field.
- Push acceptance of enhanced MR objects for ACR accreditation.
- Monitoring work items of other workgroups
  - nDimensional Presentation State
  - Injector record / Contrast Media Dose SR
  - Protocol standardization and exchange
  - New IOD for combining Classic objects into an Enhanced object
  - Registration of implants which will need extra information added to the MR objects.

#### **Current Work Items:**

- CPs, as they come from WG-06.
- Update first proposals of IHE profiles for Enhanced MR objects.
- fMRI standardization together with the fMRI technical committee of the QIBA organization

#### **Risks:**

- None

**Challenges:**

- MR applications are constantly being refined. A large number of defined terms have been standardized, but new terms should be added through CPs as soon as new techniques emerge in order to further support interoperability.
- Acceptance of Enhanced MR objects for the accreditation by the ACR
- Overall pressure on traveling increases the difficulty in getting approval for F2F meetings.

**Opportunities:**

- The fMRI and DTI discussion show that MR is getting more and more integrated in a workflow with other products and needs to work together with these products. The workgroup can explore if other usage of MR data is requiring further definition and integration of the data.

[Return to Contents](#)

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**WG-17 (3D)**

Secretariat  
Secretary

MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)  
Stephen Vastagh, MITA  
[svastagh@medicalimaging.org](mailto:svastagh@medicalimaging.org)

DICOM Assistant

Luiza Kowalczyk  
[lkowalczyk@medicalimaging.org](mailto:lkowalczyk@medicalimaging.org)

Chair

Vacant

**WG (Working Group) Profile**

Last strategy update: 2012-03-11

**Scope:**

To extend the DICOM Standard with respect to non-modality specific 3D and other multi-dimensional data sets that relate to real world domains of space, time, and physical properties, both measured or derived. The general classes of DICOM capabilities required are:

- A framework for polygonal surface data (Supplement 132). This framework is the basis of specific SOP Classes (e.g. WG-24's Implant SOP Class) or to general purpose SOP Classes, e.g. volumetric tissue classifications.
- Presentation State and annotation for multi-dimensional and polygonal storage SOP Classes.
- Extended Structured Reports for use with the multi-dimensional and surface framework.

Representative applications include: connectivity for 3D and 4D imaging modalities; data fusion; tissue classification and segmentation; Computer Assisted Detection; quantification; treatment planning; and intra-operative applications/Image Guided Therapy.

**Roadmap:**

- Move Supplement 132 to Letter Ballot (March 2008).
- Begin presentation state complement to Supplement 132.
- Develop SR extensions for reporting from multi-dimensional objects and surfaces.

**Current Status:**

WG-17 has active relationships with WG-24 (Surgery) and WG-11 (Presentation). WG-17 plans to meet two times a year, augmented by teleconferences as required. The status of WG-17 deliverables and activities is:

- Supplement 132 Polygonal Segmentation is Public Comment.

- WG-24 on Supplement 131 (Implants).
- WG-11 and WG-17 held initial discussions on Presentation State and are scheduling future interaction.

#### **Current Work Items:**

- Polygonal Segmentation (Supplement 132).

#### **Risks:**

- Availability of resources for presentation state from Wg-11.

#### **Challenges and Opportunities:**

#### **Relationships to Other Standards:**

- WG-17 evaluates relevant standards (particularly in the area of presentation) to be as consistent as possible with industry familiar standards.

[Return to Contents](#)

### **WG-18 (Clinical Trials and Research)**

Secretariat	TBD
Secretary Pro-Tem	SVastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair Pro-Tem	David Clunie MBBS, PixelMed Publishing <a href="mailto:dclunie@dclunie.com">dclunie@dclunie.com</a>

**WG (Working Group) Profile**  
Last strategy update: 2012-11-13

#### **Scope:**

To extend the DICOM Standard to support clinical trials and research using images.

#### **Roadmap:**

- Continue to evaluate issues related to performing clinical trials and research using images.

#### **Short-Term Objectives:**

- Improve support for encoding of images and image-like objects for research results (e.g. floating point parametric maps)
- Improve structured reporting support for clinical trials results and measurements.

#### **Current Status:**

- No current work item.

#### **Current Work Items:**

- A work item will be proposed to define a new IOD and SOP Class to support the encoding of floating point parametric maps.

**Risks:**

- Other groups will develop “standards” related to the performance of clinical trials that are incompatible with DICOM and hence exclude clinical production systems from use in such trials.

**Challenges and Opportunities:**

- Improve the utility of the DICOM standard for research and clinical trials.
- Broaden the participating members of the working group among workstation vendors and regulatory agencies.
- Reach out to other industry groups such as research quality assurance firms and software engineering organizations.
- Improve cross-fertilization among our group and other DICOM Working Groups

**Relationships to Other Standards:**

A strong informal relationship exists between DICOM participants and other bodies involved in clinical trials, such as NCI, ACRIN, QIN and QIBA

[Return to Contents](#)

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**WG-19 (Dermatology)**

This working group is not currently active.

[Return to Contents](#)

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**WG-20 (Integration of Imaging and Information Systems)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Co-Chair	Harry Solomon, GE Healthcare <a href="mailto:Harry.Solomon@med.ge.com">Harry.Solomon@med.ge.com</a>
Co-Chair	Helmut König, MD, Siemens Healthcare <a href="mailto:helmut.koenig@siemens.com">helmut.koenig@siemens.com</a>

**WG (Working Group) Profile**

Last strategy update: November 21, 2011

**Scope:**

Development of DICOM and HL7 standards for image-related information for areas where the consistent use of HL7 and DICOM is of prime concern, and for the coordination and mutual education and understanding between the HL7 and DICOM organizations and their technical committees/working groups.

**Roadmap:**

- Contribute to HL7 Reference Information Model (RIM) any additional classes or attributes needed for representing DICOM information model.
- Work with the Structured Document Technical Committee to develop document description for SR, resulting in the mapping of DICOM SR objects into CDA Level 3 documents.
- Develop messages supporting Imaging Integration

**Short-Term Objectives:**

- Modeling DICOM concepts in the HL7 Reference Information Model.
- Participation in HL7 Version 3 development to maximize compatibility between HL7 and DICOM.

#### **Current Status:**

- DSTU HL7 Implementation Guide for CDA® Release 2: IHE Health Story Consolidation, Release 1 - US Realm published in December 2011
- DICOM Supplement 150: “Radiation Dose Summary Information in Radiology Reports” was approved final text in August 2011
- DICOM Supplement 135: “SR Diagnostic Imaging Report Transformation Guide” was approved final text in August 2010
- HL7 CDA R2 Procedure Note Implementation Guide has been released by HL7 as DSTU in July 2010
- HL7 CDA R2 Diagnostic Imaging Report Implementation Guide has been released by HL7 in March 2009
- HL7 V3 Normative Edition 2008: Common Message Element Types COCT\_RM830110UV (A\_DicomSequence minimal) and COCT\_RM830120UV (A\_DicomCompositeObjectReference minimal) have been approved by ANSI. The patterns can be used to reference DICOM composite objects from HL7 V3 messages and CDA release 2 documents.
- DICOM Supplement 101: “Structured Document Object References” has been approved final text on June 15, 2005.
- CDA Release2: Received approval from the American National Standards Institute (ANSI) in May 2005.
- HL7 V2.5: Imaging Order (OMI) and Response Message (ORI) were approved as an ANSI Standard in 2003.

#### **Current Work Items:**

- HL7 activities:
  - Analyze cross-departmental and inter-institutional contrast agent workflow
  - Radiology/Surgery/Pathology Orders Workflow Project (Develop an implementation guide for anatomic pathology orders that better captures data from the surgical or interventional radiology procedure that produced the specimen.)
  - Work with the Orders/Observations TC on HL7 V3 Imaging Order and Results Messages and Workflow Model for Cross-Departmental Communication of Task Information
  - Update DICOM object reference CMET A\_DicomCompositeObjectReference minimal (COCT\_RM830120UV05 Release 2) to harmonize it with the HL7 V3 assertion pattern after release of HL7 V3 Data Types R2
- DICOM activities:
  - Work with DICOM WG-08 on DICOM Supplement 155 “Templates for Imaging Procedure Reports encoded in CDA”

#### **Risks:**

- Linking goals to related efforts in HL7 exposes us to delays over which we may have limited control.

[Return to Contents](#)

### **WG-21 (Computed Tomography)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	Reinhard Ruf, Siemens AG Healthcare <a href="mailto:Reinhard.Ruf@siemens.com">Reinhard.Ruf@siemens.com</a>

## **WG (Working Group) Profile**

Last strategy update: 2011-04-19

### **Scope:**

To develop and maintain the CT-specific objects for the DICOM standard in the domains of nD X-Ray imaging, technical reports, dose information and clinical information, which accompany a patient general X-ray procedure. These include (but are not limited to) acquisition, processing, storage, communication, display and reporting. The CT group pursues opportunities for further enhancements in the area of clinical interoperability for CT.

### **Roadmap:**

- The WG-21 roadmap follows a long-term strategy to specify information objects and possibly services to digitize and integrate the data flow within a CT oriented Radiography and Angiography environment.

### **Short Term Goals:**

- Identify opportunities to cooperate with Working Group 11 (nD Presentation State).

### **Current Status:**

- CT Dose Report has got a few change proposals, ongoing work (CP 1047 Dose Check support in DICOM CT Radiation Dose Report)

### **Current Work Items:**

- None

### **Challenges and Opportunities:**

- Encourage clinical users and vendors to participate in finding solutions.

[Return to Contents](#)

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## **WG-22 (Dentistry)**

Secretariat  
Secretary

American Dental Association (ADA)

Paul Bralower

[bralowerp@ada.org](mailto:bralowerp@ada.org)

Co-Chair

Veeratrishul Allareddy, American Dental Association/Univ. of Iowa

[veeratrishul-allareddy@uiowa.edu](mailto:veeratrishul-allareddy@uiowa.edu)

Co-Chair

Chris Bope: Danaher/Palodex Group/Soredex

[Chris.Bope@palodexgroup.com](mailto:Chris.Bope@palodexgroup.com)

## **WG (Working Group) Profile**

Last strategy update: 2013-12-05

### **Scope:**

To address all issues relating to the DICOM Standard for dental and maxillofacial applications including imaging and use of imaging in diagnosis, treatment simulation, treatment guidance, and tissue restoration using CAD/CAM. These include (but are not limited to) ordering, acquisition, processing, storage, communication, display and reporting.

### **Roadmap:**

The implementation of dental and maxillofacial relevant objects (e.g. PX, DX, IO, VL, SC, SR) will be emphasized for dental care environments. Specifications within DICOM are needed to promote image interoperability between

digital imaging systems for dentistry and throughout the processes of treatment simulation, treatment guidance and the CAD/CAM prosthetic value chain. Coordinated education and demonstration projects for vendors and users are essential to achieve broad adoption of the DICOM Standard in Dentistry. Extensions/refinements to existing objects will be introduced to accommodate existing and emerging digital imaging and related techniques used in Dentistry.

**Current Work Items:**

- Visible Light annex for Dental Applications
- Dental Viewsets and Query/Retrieve
- CAD/CAM Prosthetic Value Chain
- Endosseous Implants Supplement
- Radiation Dose Structured Reporting for Dental modalities

**Imminent Goals:**

- Dental Viewsets and Query/Retrieve
- Radiation Dose Structured Reporting for Dental modalities

**Future Goals:**

- Applications of WADO for dentistry
- Development of guidelines for presentation states including overlays used in dentistry
- DICOM surgical workflow issues in dentistry
- Evaluation of existing objects or current work items for use in dental imaging and use of dental images

**Risks:**

While there is heightened awareness of DICOM in the dental vendor and user communities, new vendors are entering the marketplace with increasing frequency. There is a need to introduce the new vendors to the concept of DICOM and also to explain both the advantages and limitations of DICOM to users. Further, it is necessary to continually restate that interoperability holds more advantages than disadvantages as part of the business model and also for the ethical use of radiation in diagnostic situations.

**Relationships to Other Standards:**

WG-22 anticipates working closely with the American Dental Association (ADA) Standards Committee on Dental Informatics initiatives for interoperability of all electronic media, inclusive (but not exclusive) to diagnostic images. DICOM WG 22 and has some overlap in membership with ADA SCDI WG 12.1 (Digital Imaging), and also has task groups within the Japanese Society of Oral and Maxillofacial Radiology, the American Academy of Oral and Maxillofacial Radiology, the American Association of Orthodontists and industry in Europe. ADA, AAOMR and AAO are voting members of the DICOM Standards Committee. It is recognized that the goal of interoperability for Dentistry will involve concepts that transcend DICOM and include HL7 and IHE.

[Return to Contents](#)



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## **WG-23 (Application Hosting)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Chair	Lawrence Tarbox, PhD, Mallinckrodt Institute of Radiology <a href="mailto:tarboxl@mir.wustl.edu">tarboxl@mir.wustl.edu</a>

### **WG (Working Group) Profile** Last strategy update: 2007-11-19

#### **Scope:**

To develop DICOM specifications for interfaces between hosted application software and a DICOM host system.

#### **Roadmap:**

- Stage One – Access to DICOM Datasets and Results Recording
- Stage Two – Access to Non-Interactive Application Services, such as Archiving, Printing, etc.
- Stage Three – Access to Interactive Application Services, including GUI Elements
- Stage Four – Standard Workflow Descriptions, and Interactions Between Hosted Software

#### **Short-Term Objectives:**

- Lay out a set of requirements and use cases in order to clarify the technical scope of the first stage of API development. Stage-One use cases need to be detailed and complete, but additional use cases will be useful in helping to define the Stage One scope.
- Create a functional description of the first stage API in a technology-neutral form. This description may utilize syntax and/or concepts from Web- or Grid- services.
- Create technology bindings of the API to the functional description.
- Foster an environment for trial implementations of the Stage-One API, while beginning plans for Stage-Two.
- Solicit additional input, including input from the non-DICOM community.
- Solicit additional members and resources to keep the work moving.
- Find a vendor co-chair.

#### **Current Status:**

- Trial implementations of a partial early draft of Supplement 118 from multiple sources have shown the basic concepts working.
- NCI through its caBIG™ program (IVI Workspace) is funding the development of an open-source reference implementation of the interface within the eXtensible Imaging Platform™ project.
- The WG-23 presented an update of progress and the current ideas to WG-06.
- WG-23 members have been interacting with multiple organizations, such as NIH/NCI, to lay the groundwork for a cooperative development of trial implementations

#### **Current Work Items:**

- Stage One – Access to DICOM Datasets and Results Recording (DICOM Work Item Regarding the Definition of a portable API for Post Processing Software)

#### **Risks:**

##### Short-Term

- Ensuring that the Stage One work item is of sufficient interest to the potential contributors to maintain resource levels

- Potential Intellectual Property issues
- The technical requirements of the Stage One work item may require more development than originally anticipated, requiring the work to be simplified and delayed
- The Stage One API may not have sufficient granularity to provide a solution for all use cases.

#### Long Term

- Requests for future work items will be dependent on the active participation of vendors and clinicians that perceive a need to expand the DICOM Standard in a specific area. Some items may require cooperation from other working groups, and/or a broadening of the scope of the working group.
- The technical requirements may be beyond the state of the art and therefore unfeasible.
- Regulatory issues may limit the clinical utility of the Standard.

### **Challenges and Opportunities:**

#### Challenges

- Maintaining expertise, champions, vendor and clinical participation
- Staying focused on the task at hand

#### Opportunities

- Obtain input from WG-11 (Display), WG-17 (3D), WG-18 (Clinical Trials and Education), and all of the modality-specific working groups.

### **Relationships to Other Standards:**

We anticipate referencing multiple standards from the IT/Software industry.

#### [Return to Contents](#)

### **WG-24 (DICOM in Surgery)**

Secretariat	Computer Assisted Radiology and Surgery (CARS)
Secretary	Erik Schreiber, University of Leipzig, ICCAS <a href="mailto:Erik.Schreiber@medizin.uni-leipzig.de">Erik.Schreiber@medizin.uni-leipzig.de</a>
General Chair	Heinz U. Lemke, PhD, International Society for Computer Aided Surgery <a href="mailto:hulemke@cars-int.org">hulemke@cars-int.org</a>
Co-Chair	Armin Pollmann, Zimmer GmbH <a href="mailto:Armin.pollmann@zimmer.com">Armin.pollmann@zimmer.com</a>

#### **WG (Working Group) Profile**

Last strategy update: 2014-10-02

### **Scope of WG-24**

“To develop DICOM objects and services related to image guided surgery (IGS)”.

### **Roadmap**

1. Identify and build up a user community of IGS disciplines in WG-24. Initially five surgical disciplines (Neuro, ENT, orthopaedics, cardiovascular, thoracoabdominal) and interventional radiology are selected. Anaesthesia is included as long as surgery is affected.
2. Encourage experts from vendor and academic institutions to join WG-24. Vendors of endoscopic and microscopic devices as well as implants (templates) should be included in addition to the classic vendors of medical imaging and PACS.
3. Compile a representative set of surgical workflows (with a suitable high level of granularity and appropriate workflow modeling standards and surgical ontologies) as a work reference for the scope of

WG-24. Initially, 3-5 workflows, characteristic for each discipline, should be recorded with sufficient level of detail. Workflow tools can be provided by the Innovation Center Computer Assisted Surgery, Leipzig, Germany.

4. Derive potential DICOM services from these surgical workflows.
5. Design an information/knowledge model based on electronic medical record (EMR) related work and identify IOD extensions to DICOM. Because of similarities to the IHE activities, a close relationship to IHE should be established.
6. Take account of the special image communication (1D - 5D) requirements for surgery and mechatronic devices. A close cooperation with WG-02 and WG-17 should be established.
7. Work in close cooperation with DICOM experts from radiology, cardiology, radiotherapy and related fields which are represented in other DICOM working groups.
8. Encourage close cooperation with working groups in the International Society for Computer Aided Surgery (ISCAS), Japan Institute of CARS (JICARS), German Society for Computer- and Robot-Assisted Surgery (CURAC), European Federation for Medical Informatics (EFMI), European Association for Endoscopic Surgery, American College of Surgery, International Society for Surgery, International Foundation of Computer Assisted Radiology and Surgery (IFCARS), etc.
9. Disseminate knowledge gained following the roadmap through workshops, conferences and special seminars. Special presentations should be planned each year for CARS, RSNA, DICOM-Meeting, and at a minimum for one surgical conference.
10. Connect to integration profiles specified in existing IHE Domains or in an IHE Domain in surgery (still to be determined).

#### **Short Term Goals**

1. Specify the scope of WG-24 relating to intra- and peri-operative workflows, in particular to managerial and clinical decision support for the digital operating room (DOR).
2. Consolidate the relatively large number of interested individuals of WG-24 into effective project groups.
3. The following project groups (PG) have been established:
  - PG1      WF/MI Neurosurgery
  - PG2      WF/MI ENT and CMF Surgery
  - PG3      WF/MI Orthopaedic Surgery
  - PG4      WF/MI Cardiovascular Surgery
  - PG5      WF/MI Thoracoabdominal Surgery
  - PG6      WF/MI Interventional Radiology
  - PG7      WF/MI Anaesthesia
  
  - PG131    Supplement 131: Implant Templates
  - PG132    Supplement 132: Surface Segmentation
  - PG134    Supplement 134: Implantation Plan SR Document
4. Have two WG-24 meetings per year scheduled for CARS and RSNA.

#### **Current Status:**

- A surgical PACS related IT meta architecture named Therapy Imaging and Model Management System (TIMMS) has been established. It serves as a reference for the identification of interfaces of IT systems which handle images and models for the purpose of surgical interventions.
- Supplement 132 Surface Segmentation has been accepted as a DICOM standard.
- Supplement 131 Implant Templates and Supplement 134 Implantation Plan SR Document are current work items and are expected to pass the public comment phase during 2010.

#### **Work Items in Preparation**

The following entities are being discussed with respect to their relevance as DICOM work items:

- Coordinate Systems
- Extension of Point Clouds by Colors, Properties and Observable Entities
- IOD Optical Surface Scans

- DICOM Workflows and Surgical Workflows

#### **Risks:**

- The complexity of surgical workflows (absence of good/best practice surgical procedures) render the implementation of a surgical PACS or TIMMS and the definition of DICOM objects and services a difficult task. To establish a balanced “voice of surgeons” in different surgical disciplines may require risky compromises and may not be achievable.

#### **Challenges and Opportunities:**

##### Challenges

- IGS takes on very different forms between the surgical disciplines. It is important to include the right spectrum of users from different fields of surgery and associated disciplines into WG-24. In order to reduce image communication and management functions from the different IGS disciplines to a canonical set suitable for DICOM supported services, it requires not only analytical but also innovative work.

This innovative work relates mainly to the way images from different modalities and other information entities of the patient are integrated into a multi-dimensional model of a specific patient (PSM) as well as the management of these models. Realizations of appropriate PSMs are the basis of a model-guided therapy (MGT) which is in effect what many surgical settings are practicing in training and in their actual activities in the OR.

It is therefore also important to include the right spectrum of experts from vendor and academic institutions into WG-24. An additional challenge is to achieve the above on an international level.

- Workflows for surgical procedures need to be integrated within the overall workflow of patient care, with the aim to integrate the ICT (Information and Communication Technology) island of the OR with the rest of the hospital. Contrary to many other health care activities, a generally accepted surgical ontology and good/best surgical workflow practices are not available to serve as a basis for the activities of WG-24. Links to appropriate R&D activities as well as to IHE activities relating to integration profiles supporting clinical workflows need to be and have been established.

##### Opportunities

- The digital operating room is becoming a reality. The market potential for those institutions which bring into the OR digital systems (e.g. a surgical PACS) which conform to standards, such as a suitable DICOM extension, is extremely high.
- Last but not least, patients will benefit from every step taken towards an EMR (Electronic Medical Record) which is embedded in a standard DOR infrastructure.

#### **Relationship to other Standards and Standard Bodies**

1. Geometric models (stl, vtk, ...)
2. X-ray-dose
3. anaesthesia protocols / measurements
4. Electronic patient record (IEEE/ISO 11073 part 5&6)
5. DICOM working groups
6. ISO 182 /SC2 Robots and Robotic Devices in Surgery and Medicine
7. IHE

#### **Miscellaneous**

Any comments referring to the Strategic Summary of WG-24 should be mailed to the general chair ([hulemke@cars-int.org](mailto:hulemke@cars-int.org)) of WG-24.

#### **Glossary:**

CMF – Cranio-Maxillofacial

DOR – Digital Operating Room

EMR – Electronic Patient Record  
ENT – Ear, Nose and Throat  
ICT – Information and Communication Technology  
IGS – Image Guided Surgery  
IOD - Information Object Definition  
IPD – Image Processing and Display  
MGT - Model-guided Therapy  
MI – Medical Imaging  
PSM – Patient-specific Model  
S-PACS – Surgical PACS  
TIMMS - Therapy Imaging and Model Management System  
WF - Workflow  
WFMS – Workflow Management System

[Return to Contents](#)

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## **WG-25 (Veterinary Medicine)**

Secretariat	ACVR
Secretary	Matt Wright, DVM <a href="mailto:matt@animalinsides.com">matt@animalinsides.com</a>
Co-Chair	Dennis Ballance, DVM, Sound-Eklin (a VCA Company) <a href="mailto:dwballance@ucdavis.edu">dwballance@ucdavis.edu</a>
Co-Chair	William Hornof, DVM, MS, Sound-Eklin (a VCA Company) <a href="mailto:wjhornof@eklin.com">wjhornof@eklin.com</a>

### **WG (Working Group) Profile** Last strategy update: 2010-11-29

#### **Scope:**

To develop DICOM attributes and workflow-related modifications to support identifying and describing veterinary patients, and to develop the nomenclature necessary to support hanging protocols.

#### **Roadmap:**

- Define necessary tag/attribute information to allow storage of information in DICOM image headers pertaining to breed, species, neutered state, owner, positioning, body parts, and other unique veterinary patient information as identified by the committee.
- Coordinated education and demonstration projects for vendors and users are essential to achieve broad adoption of the standard in veterinary medicine. Other activities not yet planned.

#### **Short Term Objectives:**

- Develop diagrams to support positioning and orientation definitions.
- Work with veterinary IHE implementations as issues arise.

#### **Current Status:**

- No CPs under current consideration

#### **Current Work Items:**

- None

**Long-term Objectives:**

- Maintain breed and species code lists.

**Challenges and Opportunities:**

- DICOM has become a well-accepted standard in veterinary medicine. Most companies in the market must support DICOM or be considered non-viable. A vendor-neutral “showdown” is held annually to assess DICOM file conformance, and CStore capability.
- Maintaining broad participation and focus is an ongoing challenge.
- WG 25 recognizes that there could be numerous advantages of using SNOMED CT breed terminology, but the DICOM Standard uses RT terminology. We hope to find an opportunity to incorporate CT concepts into areas of the standard that can benefit from them.

**Risks:**

- Veterinary DICOM structures could diverge from other standards (HL7, SNOMED) if careful study of these other standards is not pursued in conjunction with this process.
- User lack of understanding could slow development and adoption of standards.

**Relationships to Other Standards:**

- HL7 (Section 3.1.1, specifically 3.1.1.35 – 3.1.1.38, and 3.1.2) includes tags related to species, breed, and production use.
- SNOMED contains classifications of species, breeds, and anatomic structures.
- ISO in conjunction with HL7 manages organization UIDs

[Return to Contents](#)

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**WG-26 (Pathology) Strategy**

Secretariat (U.S) Secretary	College of American Pathologists (CAP) – U.S. meetings Mary Kennedy, CAP <a href="mailto:mkenned@cap.org">mkenned@cap.org</a> Kelly Westfall, CAP <a href="mailto:kwestfa@cap.org">kwestfa@cap.org</a>
Secretariat (Europe) Secretary	Sociedad Española de Informática de la Salud, (SEIS) – European meetings Marcial García Rojo <a href="mailto:marcial@cim.es">marcial@cim.es</a>
Chair	PathCore Inc Dan Hosseinzadeh, <a href="mailto:dan.zadeh@pathcore.ca">dan.zadeh@pathcore.ca</a>
Co-Chair	Mikael Wintell (for Europe), <a href="mailto:mikael.wintell@vgregion.se">mikael.wintell@vgregion.se</a>

**WG (Working Group) Profile**  
Last strategy update: 2011-11-30

**Scope**

To extend the DICOM Standard to support Pathology images (including cytopathology, surgical pathology, and clinical pathology and autopsy pathology studies). Specific actions are related to:

- Technical standards to facilitate pathology image acquisition, display, transfer and storage. The group will be responsible for formulating components of the DICOM Standard that relate to imaging in the domain of Pathology. The primary focus will be digital formats for clinical imaging, but digital imaging for research

applications may also be addressed as appropriate. This would include, for example, conventional imaging, whole slide microscopic imaging, micro-array imaging, flow cytometric “imaging”, and molecular “imaging”. Multi-spectral imaging shall be addressed in the context of how to properly handle the cross-channel dependencies.

- Issues related to specimen and patient identification and workflow integration. The group will address improving the information model for subject identification and workflow integration within DICOM. This is required to account for the specimen-driven nature of the subject in pathology, which differs from the primarily patient-driven model in radiology. The goal is a common model shared between DICOM and other Electronic Medical Records standards, such as HL7, that will facilitate consistent specimen identification from acquisition through analysis and reporting.
- Development of standards for integrating images and derived information into pathology reports. These include image annotation, templates for common image-based measurements and analyses, and integration of image-based information with textual and coded pathology report information, including structured pathology reports. Some of these activities may overlap with other standardization groups such as IHE and HL7, e.g. HL7 AP SR, and the group is responsible for coordinating such efforts with the respective counterparts in such groups.
- Special technical issues specific to these application domains. These include compression of multi-gigabyte imagery, as well as efficient whole slide microscopic image browsing, microscopic image analysis etc. This could also include methods for correlating clinical images (radiologic PET/CT, endoscopy, etc.) and pathology images as well as potential workflow integrations related to those.

### **Roadmap**

The WG-26 roadmap is based upon the analysis of the pathology workflow through the IHE framework to specify information objects and services to fully digitize and integrate data flow from different imaging systems within the pathology department. The ultimate goal is a comprehensive, standards-based digital platform for pathology practice, of which DICOM-based imaging is a significant part.

To be useful in the clinical environment, such a standards based digital platform must support:

- A wide range of diverse imaging approaches and systems,
- Strong interactions between said systems,
- Integration of “tissue processes” (such as histology) and “imaging processes”,
- Tight consultation between health care providers,
- Correlation of image, textual, coded, and numeric medical data (clinical imaging, ...)
- Efficient Analysis and Retrieval functionalities

Standardized interchange of correlated data is critical in this environment. There are important distinctions among:

- Acquisition and primary processing of image data in image capture systems,
- Distribution and sharing of image data among multiple systems, within and across enterprises,
- Creation of image-based analysis data and reports in workstations and software packages, and
- Persistent archive.

This group will focus on better defining the data exchange environment among these domains.

### **Short-Term Objectives**

The WG-26 work effort will be directed toward:

- Definition or extension of DICOM information object definitions for pathology:
  - Framework to properly handle multi-spectral information in WSI
  - DICOM Worklist procedures and procedure steps for:

- Requesting and staining glass slides
- Requesting and scanning WSI
- Investigation and analysis of how flow-cytometry data could be standardized, working with ISAC and ICCS.

#### **Completed Work**

- Supplement 145 to the DICOM Standard providing for “Whole Slide Microscopic Image IOD and SOP Classes” was formally approved in 2010.
- Supplement 145 to the DICOM standard introduces an SOP class for WSI
- Supplement 122 to the DICOM Standard providing for “Specimen Module and Revised Pathology SOP Classes” was formally approved in 2008.
- The Specimen Module has been harmonized with the HL7 v2 SPM segment and the HL7 v3 draft Specimen Domain Information Model.
- Supplement 122 to the DICOM standard introduces a new mechanism of pathology specimen identification and revisions to composite Information Object Definitions to use that mechanism.

#### **Current Work Items:**

- Work on adding Imaging Procedure Steps
  - CP-1148: Pathology Protocol Codes
  - CP-1149: Automated stainers
  - Supplement for Multi-spectral WSI imaging support (will get number once presented to WG06)
- Coordinating with IHE/HL7 AP in workflow

#### **Risks:**

Integration with other Electronic Medical Records standards can be difficult if they have a different approach incompatible with DICOM. Whole-slide microscopic imaging is only beginning to be used in Pathology department, and there are some technical issues (large storage needs, speed of scanning, slide reading efficiency) that need to be improved.

#### **Challenges and Opportunities**

Pathology presents specific challenges and opportunities to DICOM. In particular:

- Some pathology-related image formats do not as yet have applicable DICOM Information Object Definitions. Examples include (flow) cytometry, electron microscopy, molecular imaging (optical techniques) and others. [Note – Flow cytometry applications have much technical overlap with imaging modalities, even though they do not form an image. It will be important to make imaging standards that have cross-application utility between flow cytometry and immuno-histo-chemistry.]
- Many pathology processes (for example, flow cytometry) provide challenges in distinguishing "objective" image data from "interpretive" image information. These challenges will include specifying standards for pathology specific markup that would reliably distinguish "unprocessed" from "processes" image data, image annotations from primary image data and "constructed" images from "raw" images, etc.

#### **Liaisons and Joint Meetings with Other Relevant Standards Groups**



- Association pour le Développement de l'Informatique en Cytologie et en Anatomie Pathologique (ADICAP)
- American Telemedicine Association (ATMA) – Special Interest Group for Pathology
- Association for Pathology Informatics (API) – Laboratory Digital Imaging Project
- College of American Pathologists (CAP) – Council for Scientific Affairs (pathology reporting standards)
- DICOM WG-04 (Compression) (JPEG2000 interactive protocol and multi-component transfer syntax)
- DICOM WG-8 (Structured Reporting)
- DICOM WG-11 (Display Function Standard)
- DICOM WG-13 (Visible light)
- Health Level 7 (HL7) – Pathology Special Interest Group
- Integrating the Healthcare Enterprise (IHE) – Pathology Committee
- Japanese Society of Pathology
- Sociedad Española de Informática de la Salud, (SEIS = Spanish Society of Health Informatics)
- European Cooperation in the field of Scientific and Technical Research – COST Action IC0604 “Euro-Telepath”

#### **Future Work Items**

- Structured Reports and/or Evidence Documents in Pathology involving full demographic information;
- Correlation of radiologic and pathologic images, including image-guided biopsies;
- Coding information based upon existing WHO codification, SNOMED-CT and also ADICAP thesaurus;
- Navigating in a hierarchy of images by means of annotations of images and/or drawings (e.g., gross imaging annotated with blocks' localization);
- Integration of automated image analysis tools with WSI;
- Automation in the histology and pathology process, utilizing DICOM Worklists and other standards.

[Return to Contents](#)

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#### **WG-27 (Web Technology for DICOM)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Co-Chair	Brad Genereaux, Agfa Healthcare <a href="mailto:Brad.genereau@agfa.com">Brad.genereau@agfa.com</a>
Co-Chair	James Philbin, Johns Hopkins University / ACR <a href="mailto:james.philbin@jhmi.edu">james.philbin@jhmi.edu</a>

#### **WG (Working Group) Profile**

Last strategy update: 2013-12-05

#### **Scope:**

- Work Group 27 is focused on leveraging Web technologies and defining Web based extensions to DICOM that address the communication needs resulting from clinical use cases for medical image distribution, viewing and processing. These extensions should enable Web-based intra- and inter-enterprise communication and management of the medical imaging record and associated workflows; as well as facilitate integration with

other healthcare IT systems. Work Group 27 also coordinates its work with other standards organizations such as HL7 and IHE, so that DICOM Web Services efficiently interoperate with other Web-based medical informatics standards.

**Roadmap:**

- Add rendered images to WADO-RS
- Add Part 10 binary DICOM to all RESTful Web Services and extend XML and JSON so that all RESTful services can represent resources in binary Part 10, XML or JSON.
- Create a supplement for Unified Workflow and Procedure Step by RESTful Web Services
- Create a supplement for Notification of Availability for DICOM Objects (NADO-RS) using Web Sockets.
- Re-document Part 18 in order to improve clarity, uniformity and understandability
- Continue harmonizing our work with IHE and HL7 initiatives that are web based, so that images can be shared using the same approach as non-image documents.
- Analyze the requirements for moving Web Services to HTTP 2.0 and issue CPs and Supplements if necessary
- We will keep a keen eye on new emerging technologies in the scope intra- and cross-enterprise sharing of image information and patient medical context, and leverage these when applicable.

**Short-Term Objectives:**

- Maintain the working relationship with ISO TC 215
- Maintain the working relationship with the IHE ITI and IHE Radiology domain committees
- Maintain the working relationship with the HL7 Imaging Integration committee
- Develop supplements for the current work items.

**Final Text:**

- DICOM 3.0 PS18 Web Access to DICOM Persistent Objects. (WADO-URI)
- DICOM Supplement 148: WADO via Web Services (WADO-WS)
- DICOM Supplement 161: WADO by RESTful Web Services (WADO-RS)
- DICOM Supplement 163: Store Over the Web by RESTful Web Services (STOW-RS)
- DICOM Supplement 166: Query on ID for DICOM Objects (QIDO-RS)

**Work in Progress:**

- Web Access to DICOM persistent objects by means of Web Services (WADO), a joint work item with ISO TC 215/WG2.
- Query based on ID for DICOM Objects (QIDO)
- Notification of Availability of DICOM Objects (NADO)
- Store Over the Web (STOW)
- Unified Workflow and Procedure Step (UWPS)

**Risks:**

- Destabilize the present DICOM standard and its implementations  
To date this risk has been minimized
- Insufficient requirements input from the HIT vendors that own the applications with the patient medical context information  
To date this risk has been avoided
- Fast changing information technology in this scope, and heated debates about what's the best
- Many relationships that need to be fostered in order to obtain consistency in the approach

**Challenges and Opportunities:**

- Address the risks
- Disseminate information about the new Web-based standards to encourage adoption.
- Best use of DICOM medical images for clinical decisions within the full patient medical information context

### Relationship to Other Standards:

- Relationship with IHE ITI and RAD Work Groups
- Relationship with HL7 Imaging Integration and FHIR committees
- Relationship with ISO TC215/WG2

[Return to Contents](#)

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### WG-28 (Physics Strategy)

Secretariat-U.S. Meetings Secretary	AAPM (American Association of Physicists in Medicine) Lynne Fairbent, AAPM <a href="mailto:lynne@aapm.org">lynne@aapm.org</a>
Secretariat-European Meetings Secretary	EFOMP (European Federation of Organizations for Medical Physics) Alberto Torresin, EFOMP <a href="mailto:alberto.torresin@unimi.it">alberto.torresin@unimi.it</a>
Co-Chair	Annalisa Trianni, EFOMP <a href="mailto:trianni.annalisa@aoud.sanita.fvg.it">trianni.annalisa@aoud.sanita.fvg.it</a>
Co-Chair	Donald Peck, AAPM/Henry Ford Hospital <a href="mailto:donaldp@rad.hfh.edu">donaldp@rad.hfh.edu</a>

### WG-28 (Working Group) Profile

Last strategy update: 2012-04-18

### Scope:

- To develop or consult on CPs and Supplements requiring detailed expertise on physics and/or the needs and work of medical physicists.
- To serve as a *liaison* body to facilitate including data relevant to the physics community in DICOM objects.

### Roadmap:

- Definition of details for recording Organ Dose (including skin dose).
- Methods for capturing and recording operator dose (esp. XA).
- Evaluation of the accuracy needed for the dosimetric data registered in the RDSR
- Enhance the X-Ray Angiography Dose SR to allow skin dose maps:
  - better description of the equipment geometry, add per-frame gantry/table movement, and add an absolute patient coordinate model with respect to the equipment, better description of the patient shape...
- Acquisition, storage and application of improved calibration data (e.g. for QIBA/quantitation).
- Monitor the work of AAPM/EFOMP working/task groups.

### Short-Term Objectives:

- Eventually identify groups of interest (i.e., projection radiography, mammography, radiotherapy, nuclear medicine, etc.) and a liaison person per group.
- Establish a working relationship with AAPM Informatics Committee.
- Collaborate with EFOMP DICOM WG (Leader: Annalisa Trianni).
- Collaborate with IEC on the extensions for Radiation Dose Documentation.
- Collaborate with WG-02 to enhance the X-Ray Dose SR to address further needs in dose control and tracking.
- Write a “Physics White Paper for Patient Dose SR” that reviews data needed to be stored in terms of dose, accuracy requested, methodologies of calculation and use cases for different modalities.

- Prepare a new Work Item Request for Personal Dosimetry SR containing information provided by the electronic personal dosimeters.
- Prepare a new Work Item Request for Skin Dose SR containing the results of calculation of the dose distribution over the patient skin in interventional procedure. Potentially define a general Patient Dose SR to contain organ (and skin) dose.
- Collaborate with MITA Interventional X-Ray group for consulting on the “Physics Mode”.
- Report on new physics initiatives that impact the DICOM Standard (AAPM/EFOMP Task Groups, etc.).
  - Seek a vendor co-chair.

#### **Current Status:**

- WG-28 holds face-to-face meetings and teleconferences between the face-to-face meetings.
- Short-term goals are defined.

#### **Current Work Items:**

- Development of a Patient Dose SR to contain calculations of organ and skin dose. In collaboration with other WGs.
- Development of an Operator Dose SR to contain results of operators’ dose measurements. In collaboration with WG-02.

#### **Risks**

- Physics wish-list could get too far ahead of vendor and user expectations.
- Might not be able to recruit enough physicists, equipment vendors & service providers for the resulting specifications to be effective, balanced and adopted.

#### **Challenges and Opportunities**

- Address the risks.

#### **Relationships to Other Standards**

WG-28 members involved with IEC Subcommittees 62B and 62C will report on the impact of new and revised standards.

[Return to Contents](#)

### **WG-29 (Education, Communication, and Outreach)**

Secretariat	MITA (Medical Imaging & Technology Alliance, a Div. of NEMA)
Secretary	Stephen Vastagh, MITA <a href="mailto:svastagh@medicalimaging.org">svastagh@medicalimaging.org</a>
DICOM Assistant	Luiza Kowalczyk <a href="mailto:lkowalczyk@medicalimaging.org">lkowalczyk@medicalimaging.org</a>
Co-Chair	Charles Kahn, American College of Radiology <a href="mailto:kahn@mcw.edu">kahn@mcw.edu</a>
Co-Chair	Jeroen Medema, Philips Healthcare <a href="mailto:Jeroen.medema@philips.com">Jeroen.medema@philips.com</a>

**WG (Working Group) Profile**  
Last strategy update: 2013-09-12

**Scope:**

The goal of WG-29 is to coordinate DICOM education, communication, and outreach efforts with all current and potential stakeholders, including patients, health care providers, policymakers, and developers.

**Education:**

- Organize the DICOM International Conference
- Define competency requirements for target audiences
- Discuss whether to accredit educational providers, and if so, how
- Define the content that should be provided

**Communication:**

- Develop and maintain an Executive Summary document to explain and define DICOM's role in healthcare
- Redesign and manage the DICOM website
- Optimize the DICOM community communication methods (listserv, FTP)

**Outreach:**

- Create printed articles and/or video presentations about DICOM
- Assist with implementation and use of new supplements including through support to customers and manufacturers
- Establish reciprocal connections with patient advocates, policy makers, medical informatics leaders, and others

**Short-term goals:**

- Reclaim ownership of "dicom.org" domain name
- Redesign and revise DICOM web site
- Begin planning process for next DICOM International Conference
- Create "executive summary" document to describe DICOM's role in health care
- Begin outreach efforts with policymakers and non-imaging informatics experts

[Return to Contents](#)

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**WG-30 (Small Animal Imaging)**

Secretariat	NIH (National Institutes of Health)
Secretary	Eve Shalley <a href="mailto:eve.shalley@nih.gov">eve.shalley@nih.gov</a>
Chair	Joseph Kalen, Small Animal Imaging Program <a href="mailto:Joseph.Kalen@nih.gov">Joseph.Kalen@nih.gov</a>

**WG (Working Group) Profile**

Last strategy update: New Working Group – Profile under development

**Scope:**

**The goal of WG-30 is**

**Roadmap:**

**Short-Term Objectives:**

**Current Work Items:**

**Risks:**

**Challenges and Opportunities:**

**Relationships to Other Standards:**

[Return to Contents](#)

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