

# THE DICOM 2013 INTERNATIONAL CONFERENCE & SEMINAR

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## Trends and future in DICOM standardization

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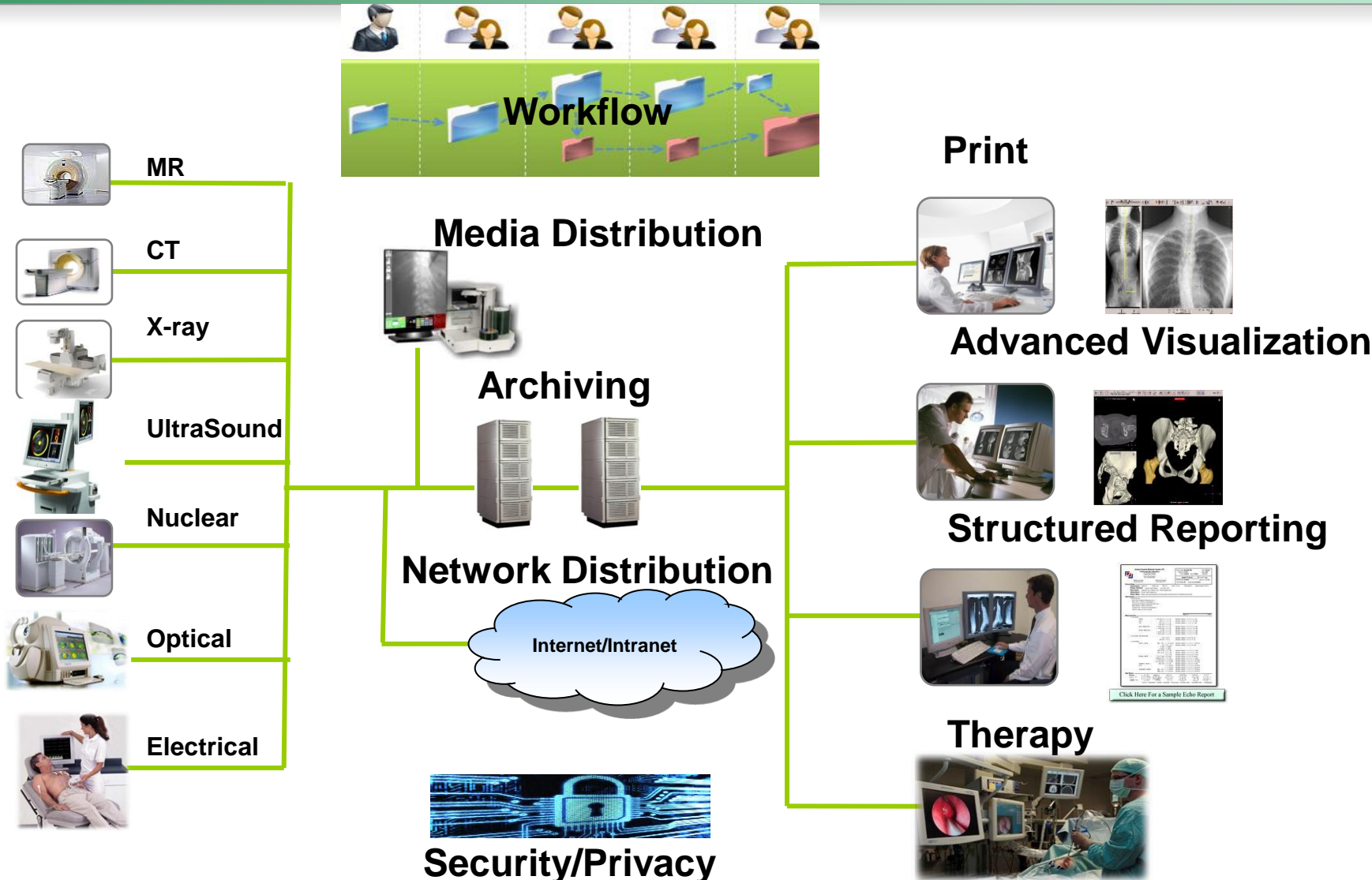
Best, The Netherlands

Co-chair DICOM WG10 Strategic Advisory [2001-2012]

## Outline

- ❖ **Overview of the DICOM domain**
- ❖ **DICOM vectors over years 1993-2013, & future**
- ❖ **Trend summary**
- ❖ **Conclusion**

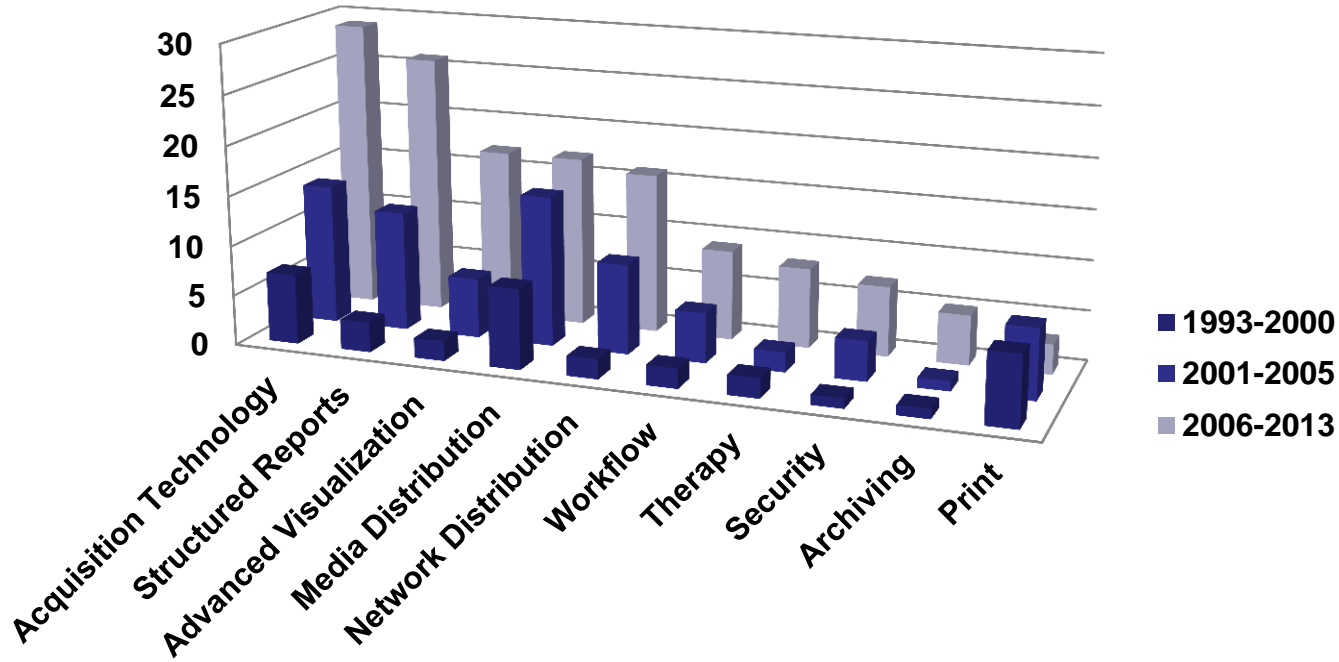
Acquisition Technology



≈160 new supplements since 1993



## Growth of supplements



# Acquisition Technology

## Drivers:

- Clinical domains:
  - Ophthalmology
  - Pathology
- Resolution
- Speed
- 3D
- Optics
- Intravascular

## What's next:

- Hybrids
- New technology



1993

2000

2006

2013

2018

# Structured Reporting

## Drivers:

- Radiation Dose
- CAD
- US
- Cardio
- Vascular

## What's next:

- Clinical specialty needs
- Use of patient history for quality of healthcare improvement



1993

2000

2006

2013

2018

# Advanced Visualization

## Drivers:

- Display consistency
- Ease of use
- Ease of re-use
- 3D
- Quantitative Measurement  
Visualization

## What's next:

- Clinical specialty needs
- In Volume visualization



1993

2000

2006

2013

2018



## Drivers:

- Data explosion
- Consumer market media

## What's next:

- Cloud



1993

2000

2006

2013

2018

# Network Distribution

## Drivers:

- Transfer speed
- Web and Information Technology

## What's next:

- Wireless
- Mobile



1993

2000

2006

2013

2018

# Workflow

## Drivers:

- Efficiency in image acquisition, post-processing, reporting, therapy planning
- Data integrity

## What's next:

- Regional workflow



1993

2000

2006

2013

2018

# Therapy planning and interventions

## Drivers:

- Radiotherapy
- Surgery

## What's next:

- Image guided interventions
- Augmented reality



1993

2000

2006

2013

2018

# Security

## Drivers:

- Privacy concerns
- HIPAA

## What's next:

- Deployment



1993

2000

2006

2013

2018

## Drivers:

- DICOM Composite object model
- Clinical applications

## What's next:

- Distributed archives
- Regional/National
- Cloud



1993

2000

2006

2013

2018

## Drivers:

### Quality

- Resolution
- Max Density
- Consistency

### ➤ Ease of Use

### ➤ Cost of Ownership

## What's next:

### ➤ The End?



1993

2000

2006

2013

2018

- ❖ Technology is a constant innovative driver for change, and new **Acquisition Technologies** will emerge, needing their encoding in DICOM objects.
- ❖ Continuous quality improvement of the clinical practice by evidence-based medicine, requiring deeper and broader semantic interoperability for data mining. This will lead to more DICOM **Structured Reporting** templates for evidence documents and CAD.
- ❖ The amount of acquired data by the acquisition modalities will continue to grow. The resulting information tsunami will require more use of 3D and 4D **Advanced Visualization and Processing** tools, and a continuous drive for speed in the **Network Distribution**. The need to support and orchestrate the post-acquisition processing, diagnostic and therapy **Workflow** will grow.
- ❖ The focus on the patient's care cycle and clinical pathway through the healthcare enterprise will need a closer linkage between diagnosis, **Therapy planning**, and **Image Guidance during Surgical Interventions**.
- ❖ The geographical scope of imaging solutions has increased to regional solutions, and clinicians (and patients) want location independent, mobile, access to imaging information, with a **link to the Electronic Patient Record**. **Network Distribution using Web Technology** will be an important enabler for this trend.



- ❖ Access needed to both imaging data in DICOM and the rest of the patient's clinical information in HL7.
- ❖ There are two domains: acquisition devices to PACS, and around and beyond the PACS. Web Technology will dominate the latter domain.
- ❖ DICOM will continue to grow to a total of 200 supplements in 2018 when celebrating 25 years of DICOM in South-Africa.



***Thank you for your attention !***



<http://medical.nema.org/dicom/geninfo/Strategy.pdf>



<http://www.hl7.org/implement/standards/fhir/>



<http://www.IHE.net/>

**Note:** references to original pictures retrieved from the Internet and used this presentation are included in attached hyperlinks

## Cor Loef

- <http://www.linkedin.com/pub/cor-loef/1/911/650>

# Acquisition 1993-2000

## # Title

4	X-Ray Angiographic Image Objects and Media Storage
6	X-Ray Fluoroscopic Image Object
7	Nuclear Medicine Image Object
12	PET Image Object
15	Visible Light Image (Single Frame)
30	Waveform Interchange
32	Digital X-Ray



## # Title

49	Enhanced multi-frame MR Object
58	Enhanced CT Image Object
47	Visible Light Video
91	Ophthalmic Photography IODs
48	Intravascular Ultrasound IOD and Application Profile
45	Ultrasound Protocol Support
84	Ultrasound Region Calibration Clarification



#	Title
43	3D (multi-dimensional) Ultrasound IODs and SOP Classes
116	3D X-Ray
83	Enhanced XA and XRF Image Storage SOP Classes
139	Enhanced XA/XRF IOD Informative Annex
117	Enhanced PET Image Storage SOP Class
141	Enhanced MR Color Image Storage SOP Class
110	Ophthalmic Coherence Tomography (OCT) Storage SOP Class
144	Ophthalmic Axial Measurements Storage SOP Class
146	Ophthalmic Visual Field (OPV) - Static Perimeter Measurements Storage SOP Class.
152	Ophthalmic Thickness Map Storage SOP Class
145	Whole Slide Imaging in Pathology
122	Specimen Identification and Revised Pathology SOP Classes
125	Breast Tomosynthesis Image Storage SOP Class
151	Intravascular Optical Coherence Tomography Image Storage SOP Class
154	Optical Surface Scanner Storage SOP Class



# Structured Reporting 1993-2000

## # Title

23	Structured Reporting
36	Codes and Controlled Terminology
26	OB-GYN Ultrasound Procedure Reports



# Structured Reporting 2001-2005

## # Title

53	DICOM Content Mapping Resource
50	Mammography CAD
65	Chest CAD SR SOP Class
79	Breast Imaging Report
66	Catheterization Lab SR SOP Classes
72	Echocardiography SR
76	Quantitative Arteriography and Ventriculography SR
71	Vascular Ultrasound SR
77	Intravascular Ultrasound SR





# Structured Reporting 2006-2013

#	Title
94	Radiation Dose Reporting
150	Radiation Dose Summary Information in Radiology Reports
159	Radiopharmaceutical Administration Radiation Dose Reporting
127	CT Radiation Dose Reporting (Dose SR)
126	Colon Computer-Aided Detection SR SOP Class
97	CT/MR Cardiovascular Analysis Report
128	Cardiac Stress Testing Structured Report
78	Fetal and Pediatric Echocardiography SR
129	Electrophysiology Structured Reports and Procedure Log Templates
130	Ophthalmic Refractive Structured Reports
143	Reporting of Macular Grid Thickness and Volume SR Template
135	SR HL7 CDA Mapping
155	Imaging Procedure Reports encoded in CDA template
115	Evidence Document SOP Classes



# Advanced Visualization 1993-2000

## # Title

28	Grayscale Standard Display Function
33	Soft Copy Presentation State Storage



## # Title

57	Expanded Secondary Capture
100	Color Presentation State
59	Key Object Selection SOP Class
73	Spatial Registration



## # Title

60	Hanging Protocol Object
123	Structured Display
133	Color Palette Storage SOP Class
124	Communication of Display Parameters
120	Extended Presentation States
156	Multi-Dimensional Presentation State
140	XA/XRF Grayscale Softcopy Presentation State Storage SOP Class
103	Real World Mapping SOP Class
111	Segmentation Storage SOP Class
112	Deformable Image Registration
157	Multi-Frame Converted Legacy Images



## # Title

1	Media Storage and File Format For Media Interchange
2	Media Storage Application Profiles
3	Media Format and Physical Media Interchange
27	Media Formats and Physical Media for Data Interchange
19	General Purpose CD-R Interchange Profile
18	Media Storage Application Profile for CT and MR Images
20	X-ray Cardiac (1024) Media Application Profile
25	Ultrasound Application Profile Media Extensions



## # Title

40	DVD using UDF Media
62	Higher Capacity MOD FAT 16 Media
69	640 MB and 1.3 Gbyte 90mm MOD Medium format and use in US profiles
80	DVD-R Media Application Profile
87	USB and Flash Memory Media Application Profiles
88	Media Creation Management SOP Class
92	Media Application Profile for Dentistry



## # Title

82	2.3 Gbyte 90mm MOD Medium Format for use in US profiles
153	Blu-ray Disc Media Application Profiles



# Network Distribution 1993-2000

## # Title

5	Ultrasound Application Profile IOD and RLE Transfer Syntax Extension
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14	Unknown Value Representation
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# Network Distribution 2001-2005

## # Title

42	MPEG Transfer Syntaxes and Encoding
61	JPEG 2000 Transfer Syntaxes
54	DICOM MIME Type
85	Web Access to DICOM Persistent Objects
67	Configuration Management
44	Clarify Network Addressing and Retire Non-TCP/IP Communication
90	SOP Class Relationships Negotiation



# Network Distribution 2006-2013

## # Title

105	JPEG 2000 Part 2 Multi-component Transfer Syntaxes
106	JPEG 2000 Interactive Protocol
137	MPEG2 MP@HL Transfer Syntax
149	MPEG-4 AVC/H.264 Transfer Syntax
113	Email Transport
148	WADO via Web Services
161	WADO by means of RESTful Services



# Workflow 1993-2000

## # Title

10	Basic Worklist Management (Modality)
17	Modality Performed Procedure Step SOP Class



## # Title

75	Relevant Patient Information Query Service Class
93	Instances Availability Notification
52	<i>General Purpose Worklist</i>



## # Title

96	Unified Worklist and Procedure Step
89	Worklist and Performed procedure Step Use Cases
121	Modality Procedure Plan and Protocol Storage
74	Utilization of Worklist in Radiotherapy Treatment Delivery
160	Second Generation RadioTherapy - Patient Positioning and Workflow



# Therapy planning and interventions 1993-2000

## # Title

11	Radio Therapy IODs Phase 1
29	RT Treatment Record IOD



# Therapy planning and interventions 2001-2005



# Title

#	Title
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# Therapy planning and interventions 2006-2013

## # Title

102	Radiotherapy Extensions for Ion Therapy
147	Second Generation Radiotherapy
132	Surface Segmentation Storage SOP Class
131	Implant Templates
134	Implantation Plan SR Document Storage SOP
138	Crestal Implant Storage SOP Class





# Security 1993-2000



## # Title

31	Security Enhancements One: Transport Layer Security
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## # Title

41	Security Enhancements Two: Digital Signatures
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51	Media Security
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55	Attribute Level Confidentiality
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## # Title

95	Audit Trail Messages
86	Digital Signatures for Structured Reports
142	Clinical Trial De-identification Profiles



# Archiving 1993-2000



#	Title
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8	Storage Commitment Service Class
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# Archiving 2001-2005



**# Title**



## # Title

104	DICOM Encapsulation of PDF Objects
114	DICOM Encapsulation of CDA and CDR
118	Application Hosting
119	Instance and Frame Level Retrieve SOP Classes



## # Title

37	Printer Configuration SOP Class
22	Presentation LUT (Print)
38	New Basic Image Overlay Box SOP Class
0	<i>Print Management Point-to-Point Communication Support</i>
13	<i>Queue Management (Print Queue SOP Class)</i>
24	<i>Stored Print related SOP Classes</i>
39	<i>Stored Print Media Storage</i>



Print 2001-2005



**# Title**

|--|--|





**# Title**

|--|--|

