Supplement XXX

NEUROPHYSIOLOGY WAVEFORMS

DICOM WORKING GROUP 32

FIRST READ

SILVIA WINKLER, DAVID CLUNIE

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Introducing Working Group 32

ORGANIZATION AND PURPOSE

Introducing Working Group 32

Chaired by:

- Jonathan Halford
  Medical University of South Carolina (MUSC)
- Shiv Sabesan
  Philips Neuro

Secretary:

- The International Federation of Clinical Neurophysiology (IFCN)
  Monica Sayers

Introducing Working Group 32

Where Members come from …

- Medical
  - German Society of Clinical Neurophysiology and Functional Imaging
- Academic
  - Austrian Institute of Technology
  - Ludwig-Maximilians-University of Munich
  - Universidad de la República (Uruguay)
- Industry
  - Canon, CortexXus, Moberg, Neuralynx, Nihon Khoden, Persyst, Philips

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Ultimate goal is

- a comprehensive, standard-based digital platform for neurophysiology in the patient care setting

New specification should

- Leverage the existing and growing ecosystem of DICOM-capable systems in use in healthcare institutions
- Leverage standards already in use in the neurophysiology industry

Introducing Working Group 32

Short-term objectives:

- New IOD(s) for storing neurophysiology data in PACS or VNA
  - Direct association with the patient
  - Together with related objects such as video or ECG
  - Keeping data synchronized
- Gap analysis of existing DICOM Standard with respect to potential neurophysiology requirements (e.g. waveform compression)
- Identify and establish relationship to other DICOM Working Groups currently responsible for related features
- Priorities for the identified gaps

Introducing Working Group 32

How this happened:

- IFCN Task Force in 2018
  - "Common Standard Format for Neurophysiology Data Exchange"
- In Vienna some research projects were initiated:
  - Using DICOM Waveforms for EEG and Sleep Studies
  - Proofed EHR integration, EEG analysis algorithms running on DICOM Waveforms
- Clear vote of the IFCN Task Force for DICOM
- Kickoff for Working Group 32 in Dec. 2018

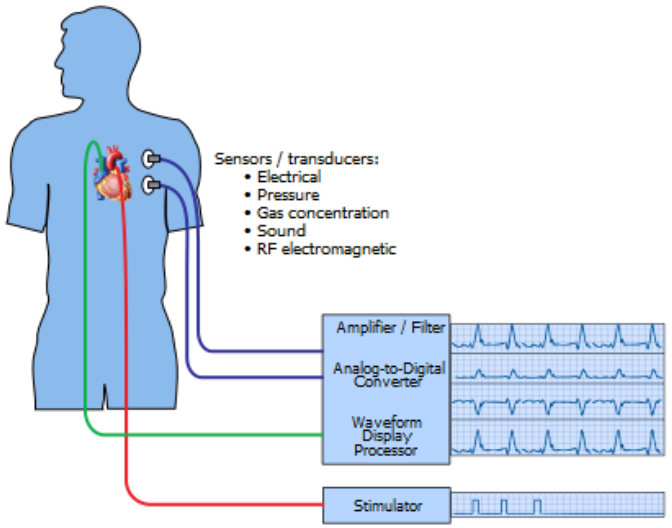
Neurophysiology Waveforms

EXTENDING DICOM WAVEFORMS TO NEW DOMAINS

DICOM Waveforms

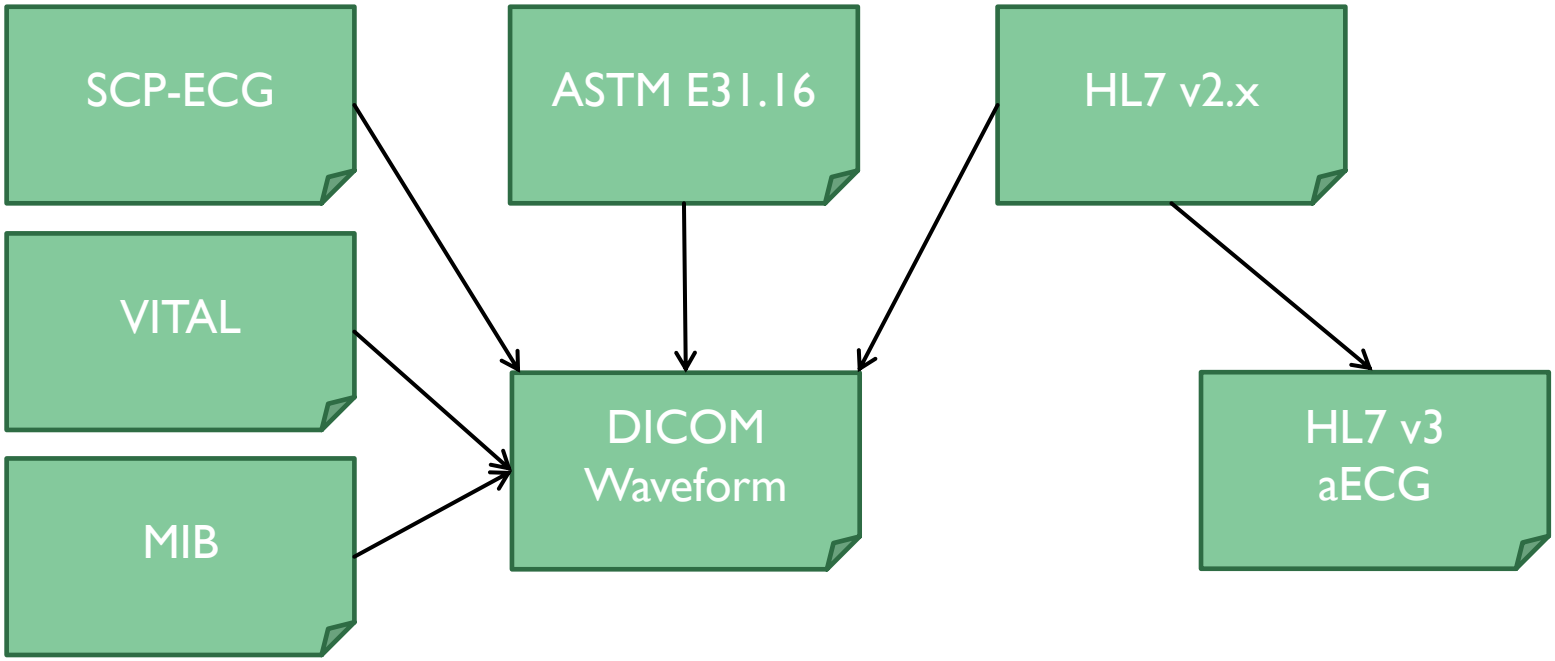
DICOM Support since 2000

- Audio: 2 SOP Classes
- ECG: 3 SOP Classes
  - 12-lead, General ECG, Ambulatory
- Arterial Pulse Waveform
- Respiratory Waveform
- Basic Cardiac Electrophysiology
- Hemodynamic



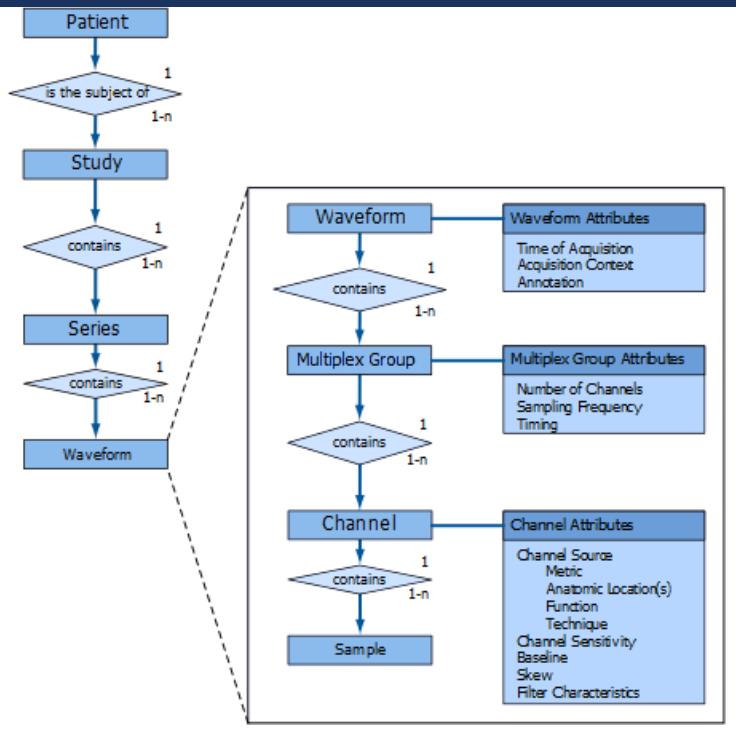
DICOM PS3.17 Fig. C.4-1.

DICOM Waveforms



DICOM Waveforms

- Waveform Attributes
  - Acquisition Time
  - Acquisition Context
  - Annotations
- Channel Multiplexing
- Channel Attributes
  - Channel Source
  - Scaling
  - Callibration
  - Filter
- Sample Values



DICOM Waveform Information Model PS3.17 Fig. C.5-1

DICOM
Digital Imaging and Communications in Medicine

Clinical Scenarios

Scenario	Recording	Indication
Routine EEG	Scalp EEG	Encephalography, epilepsy
EEG-Video-Monitoring	Scalp EEG	Seizure characterization, presurgical epilepsy evaluation
EEG-Video Monitoring – intracranial	Implanted electrodes	presurgical epilepsy evaluation
Longterm EEG Monitoring	Scalp EEG	Encephalograpyh, epilepsy, ICU
Polysomnography	Scalp EEG, EMG, EOG + additional	Sleep disorders
High-density EEG	More Electrodes, req. 3D localization	
EEG-fMRI	Sync. Acquisition of EEG and MRI	

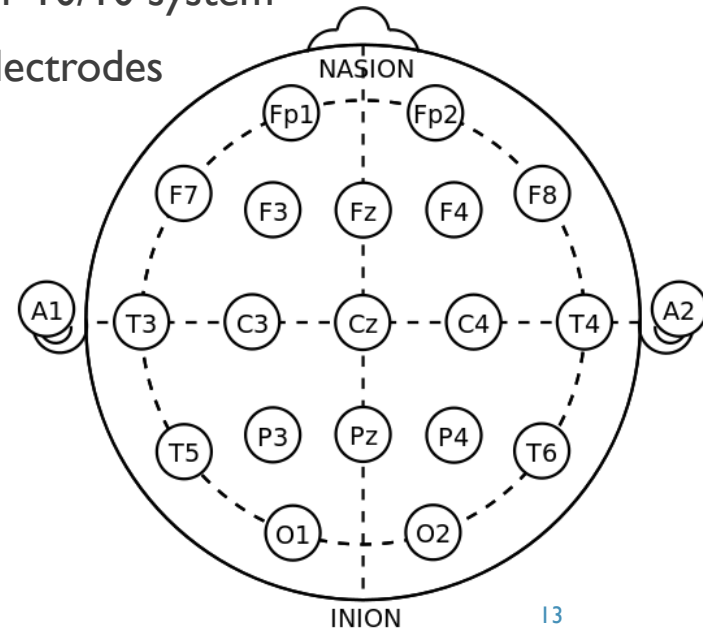
Routine Scalp EEG

Properties

- Electrode positions according the international 10/20 or 10/10 system
- Maybe alternative setting using a cap instead of single electrodes
- Up to 32 channels, sampling frequency up to 1024 Hz
- Additionally recorded: single ECG channel

Nomenclature: ISO IEEE 11073 10101

- Leads
  A.8.4 Sites for EEG-electrode placement on the head
- Annotations



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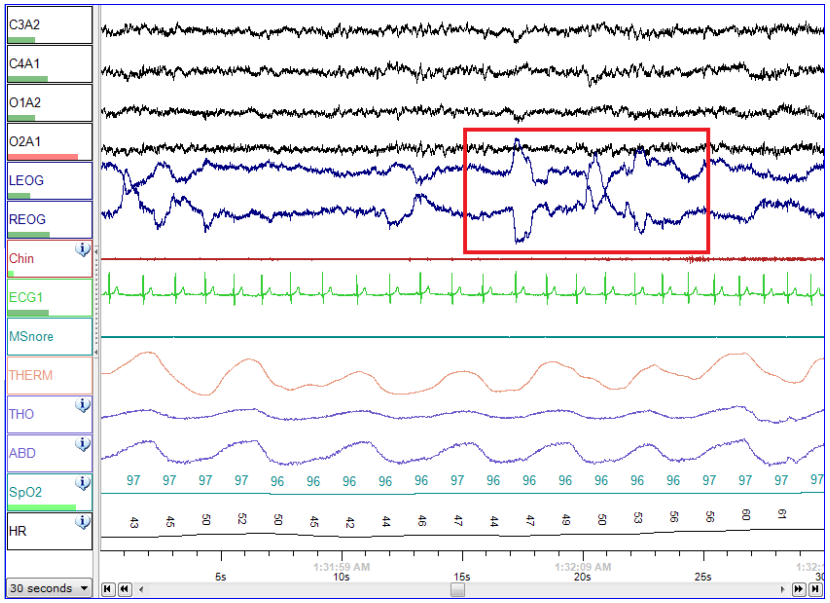
Polysomnography

Multimodal recording:

- Additionally required:
  - EMG (activity of skeletal muscles)
  - EOG (eye activity)
- Reuse of existing objects:
  - Video
  - arterial pulse waveform (pulse oximetry)
  - sound recordings

Nomenclature: ISO 11073 10101



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Why this makes sense ….

- Compatible to / reuse of existing objects
  - ECG, pulse oximetry, respiratory, video and synchronization
  - Probably methods to spatially align with imaging in case of intracranial recording
- No silos: data will be semantically interoperale in terms of
  - Locations, annotations, and acquistion context
- Integration to clinical infrastructure
  - PACS, VNA, EHR, …

Still in Discussion ....

- Final Set of Objects
- Missing nomenclatures
- Some technical topics like impedance measure, photic stimulation, etc.
- Waveform Compression Algorithms