



DICOM Secretariat/MITA
 1300 North 17th Street, Suite 900
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<http://www.dicomstandard.org/>
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MINUTES

MEETING NAME WG-32

MEETING PLACE/DIAL IN Via Zoom

DATE & TIME Thursday 19 Sept 2024
 10:00– 11:00 AM Eastern Daylight Time (EDT)

PRESIDING OFFICERS Jonathan J. Halford, Medical University of South Carolina,
 User Co-Chair
 Andrew Ehrenberg, Nihon Kohden Corporation,
 Vendor Co-Chair

IFCN SECRETARIAT Kim Zaiss

DICOM SECRETARIAT Shayna Knazik

Present	First Name	Last Name	Organization	Voting Status
	Emmanuel	Cordonnier	b<>com	Voting
	Kevin	O'Donnell	Canon Medical Research USA, Inc.	Voting
	Felix	Rosenow M.D.	DGKN (German Society of Clinical Neurophysiology and Functional Imaging)	Voting
x	Jan	Remi	Ludwig-Maximilians-University of Munich	Voting
x	Ben	Brinkmann	Mayo Clinic	Voting
x	Jonathan	Halford	Medical University of South Carolina	Voting
x	Andrew	Ehrenberg	Nihon Kohden Corporation	Voting
	Alan	Huang	Philips	Voting
	Wim	Corbijn van Willenswaard	Philips	Alt. Voting
	Justin	Dauwels	TU Delft	Voting
	Jeroen	Medema	Philips	Alt. Voting
x	Raymond	Kraskinski	Philips	Observer
	David	Clunie	PixelMed Publishing	Voting
x	Silvia	Winkler	Sigma Software Solutions	Voting
	Ana	Alves	CortexXus Inc.	Observer
x	Guisepppe	Campobello	University of Messina	Observer
	David	Alves	CortexXus Inc.	Observer
	Babak	Razavi	CortexXus Inc.	Observer
	Matt	Stead	Dark Horse Neuro, Inc.	Observer
	Andrea	Bigazzi	EB Neuro	Observer
	Gritsch	Gerhard	AIT Austrian Institute of Technology GmbH	Observer
	Mateo	Pratesi	EB Neuro	Observer
	Ignacio Ramírez	Paulino	Facultad de Ingeniería - Universidad de la República	Observer



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	Sandor	Benizcky	Filadelfia	Observer
	Steve	Nichols	GE Healthcare	Observer
	Gardar	Thorvardsson	Kvikna / Stratus EEG	Observer
	Richard	Moberg	Moberg Research, Inc.	Observer
	Desire	Jean		Observer
	Casey	Stengel	Neuralynx	Observer
	Bill	Antilla	Nihon Kohden Corporation	Observer
	Ryuzo	Mase	Nihon Kohden Corporation	Observer
	Koichiro	Matsumoto	Nihon Kohden Corporation	Observer
	Pedro Fernando	Arizpe Gomez	OFFIS e. V.	Observer
	Daniel	Crepeau	Dark Horse Neuro	Observer
	Andrey	Pirozhenko	Persyst	Observer
	Shane	Ponzikoff	Persyst	Observer
	Wouter	Potters	Amsterdam UMC, Netherlands	Observer
	Stefan	Rampp	University Klinikum Erlangen	Observer
	Dagmar	Krefting	University Medical Center Göttingen	Observer
	Marco	Rossi	University of Milan, Italy	Observer
	Gloria	Menegaz	University of Verona, Italy	Observer
	Matan	Oppenheim	Zebra Medical Vision	Observer
	Jonathan	Pfaff	Fraunhofer Heinrich Hertz Institute HHI	Observer
	Gary	Sullivan	ITU-Rapporteur	Observer
x	Kristian	Bernard Nilsen	Oslo University Hospital	Observer
x	NS	Nagarajan	GE Healthcare	Observer
	Bruno	Monnerat		Observer

1. CALL TO ORDER AND REVIEW OF ANTI-TRUST RULES AND DICOM PATENT POLICY

The meeting was called to order at 10:02 AM EDT. Participants were reminded that the Guidelines for Conducting NEMA Meetings and Patent Disclosure Policy are in effect and they may be found here: <https://www.dicomstandard.org/patent>.

2. WELCOME/ATTENDANCE/INTRODUCTION

Attendance was taken.

3. REVIEW AND APPROVE AGENDA

The agenda was reviewed, motion to approve by JH and seconded by BB.

4. REVIEW MINUTES

The minutes of the 15 Aug 2024 meeting were reviewed, motion to approve by JH and seconded by BB.

5. OLD BUSINESS

- **Supplement 236 (Presentation State for montage and visualization filters).** SW reported that Supplement 236 is in the Letter Ballot stage. SW gave a summary of relevant process for Supplement development: Recently SW (the Editor for DICOM WG-32) brought the revised Supplement 236 document, together with an account of how past comments have been addressed, to WG-06 for a detailed line-by-line review. (WG-06 is the Base Standard committee, which provides technical guidance to all DICOM working groups and serves as the technical coordination point for DICOM.) In this process, Supplement 236 was reviewed by WG-06 line-by-line and verified for any inconsistencies with the existing Standard and other Supplements in progress. Approximately a month ago, WG-06 gave its approval, and SW prepared the Supplement 236 document for the letter ballot stage. ~~The~~he next step is review by NEMA's legal counsel, after which the DICOM Secretariat will forward Supplement 236 to the DICOM Standards Committee (DSC) for letter ballot (vote). Each DSC member is allowed 35 days to cast their ballot. DSC members have four possible vote options: approve, approve with comments, disapprove with comments, and abstain. Following the letter ballot, the DICOM Secretariat will report the results to WG-06 and sends any ballot comments to WG-32. It will be the responsibility of WG-32 to address all letter ballot comments and suggest to WG-06 a final text for Supplement 236. SW reported that WG-06 will probably review final text for Supplement 236 at the November WG-06 meeting.
- There was discussion of **International Telecommunications Union Standardization Sector (ITU-T) Call for proposals (CfP) for biomedical waveform coding** released on 26 Apr 2024 with responses to this requested for consideration at the ITU-T Q6/16 meeting planned for 30 October – 8 November 2024 in Antalya, Turkey (exact dates to be announced).
 - JH apologized for having sent out the EEG dataset component of the CfP test vector from his medical university with time/date codes included (but otherwise de-identified), because he misunderstood and thought that including the data/times of service was necessary for encoding of time-based waveform signals. JH asked JP if the ITU-T CfP for biomedical waveform coding was still in process. JP responded that ITU-T had decided that the CfP would proceed with the existing test vector. JH reported that he was in discussions with his medical university about this and would modify the existing EEG component of the CfP test vector to include the same waveforms but with the time/date codes and other identifying information removed and send this modified dataset to JP via FTP. It was discussed that the ECG and EMG dataset components of the CfP test vector were completely de-identified and had been released on the web years ago for public use.

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- JH stated that, as discussed in previous WG-32 meetings, the current CfP test vector has significant limitations from the standpoint of codec development:
 - The EMG data is surface EMG data and neuromuscular neurologists do not generally use surface EMG data clinically but instead use intramuscular needle EMG data, which has a different waveform morphology and is sampled at a much higher rate of up to 50 kHz [See IFCN Standards of instrumentation of EMG at <https://pubmed.ncbi.nlm.nih.gov/31761717/>]
 - Most of the EEG data in the test vector is surface EEG data sampled at 256-512 Hz and only 10 of 41 EEG datasets in the test vector consist of intracranial EEG data sampled at 2kHz. JH noted that encoding of intracranial EEG is potentially more challenging than surface EEG due to many more channels and much higher sampling rates. Many research intracranial EEG recordings include sampling rates much higher, such as up to 40 kHz and the number of channels in the EEG test vector is limited because the surface EEG data has only 19 channels (standard 10-20 montage) and the intracranial EEG data has ~100 channels per recording. But some clinical intracranial recordings currently have many hundreds of channels (such as microelectrode recordings).
 - Bit depth of the EEG and EMG data is 16 but there is a trend towards increasing bit depth of neurophysiology waveform recordings up to 24.
- JH stated that, given the limitations of the EMG and EEG data in the CfP test vector, he is working on collecting biomedical waveform data which could be used by ITU-T for further testing of codec reference software. JH stated that he had been sent human research needle EMG data in CSV format from a researcher in Europe which he is reformatting in MATLAB. JH also mentioned that BB had sent him intracranial EEG data with bit depth 18. SR has sent him further intracranial EEG data. JR stated that he would also upload intracranial EEG data which could be added to this archive. It was agreed by the group that a decision would be made on how to reformat this intracranial data for use by ITU-T Q6/SG16, since European Data Format (EDF), which is used for the CfP test vector, cannot be used for encoding because it can only encode with bit depth up to 16.
- It was discussed how WG-32 could contribute to the testing of codec reference software submitted as part of the ITU-T CfP. JH stated that it was his understanding that the testing of CfP reference software performance was the responsibility of ITU-T Q6/SG16 and JP agreed with this. JH asked JP what WG-32 could do to contribute to the testing of codec reference software. JP responded:
 - JP requested to confirm with WG-32 that it was the intention of WG-32 to use the standard codec that would be produced by the recent ITU-T CfP for biomedical waveform coding in future IOD development. JH stated that, to his knowledge, there did not exist a standardized codec for biomedical waveforms and that [based on recent work published by

Battaglia et al; <https://ieeexplore.ieee.org/document/10596834>], current audio codecs are not sufficient for biomedical waveform coding because they used psychoacoustic masking models (which removed important high frequency content) and their input sampling rate requirements are quite different from that needed for neurophysiology data. JH asked BB to confirm that there was not a standard codec that WG-32 could use for neurophysiology data, and BB concurred. JH stated that it was the intention of WG-32 to use the codec produced by the ITU-T CfP in the upcoming WG-32 LTM EEG and Sleep Monitoring IOD and many other future neurophysiology IODs.

- JP stated that it would be helpful if WG-32 could develop a statement of the required features of a codec for biomedical waveforms, which could be used by ITU-T to help guide the codec reference software development process. Participants including JH, BB, and SW agreed that WG-32 should proceed with creating such a document to provide guidance to ITU-T Q6/SG16. There was discussion of what this guidance document should include. JH mentioned that the codec needed to provide not only good compression performance but also needed to address rapid access. JP remarked that he was very aware of this issue because, although compression ratio would be optimized if an entire video dataset was compressed in one block, rapid access is also an important feature for video encoding and so ITU-T always works to address the tradeoff between blocking/indexing for rapid access and compression ratio optimization.
- JP stated that he thought that testing of codec reference software using the recently developed web-based EEGnet annotation process was useful and he requests that this be performed with future novel codec reference software that is being considered by ITU-T for standardization, in order to establish the threshold of lossy distortion that clinical neurophysiologists can perceive. [This process using clinical neurophysiologist expert opinion on original EEG signal versus lossy MPEG-AAC audio codec compressed/decompressed EEG signal has been tested and results presented recently by Battaglia et al; see <https://ieeexplore.ieee.org/document/10596834>].
- **Sensor Name and Location Subcommittee (SNALES) Update.** JH reported the SR had communicated to him that he could not attend the WG-32 telecon today because he had responsibilities an ongoing conference, but that he continued to work on the SNALES project and had made contact with workgroups who are standardizing the names of intracranial EEG recording locations. He stated that he will report on this at the October WG-32 telecon.



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- **WG-32 FTF Meetings.** JH reported that he had polled WG-32 participants via email within the last month and not many were going to be at the American Epilepsy Society (AES) Annual Conference in Los Angeles in early December 2024. Because of this, and because WG-32 did not have any funds currently to support a FTF meeting with teleconferencing, he had decided that WG-32 would not have a formal FTF meeting at this conference. JH stated that he thought a good conference for a WG-32 FTF meeting would be the International Federation of Clinical Neurophysiology (IFCN) conference in London in Sept 2025. JR suggested the WG-32 participants already committed to attend the AES meeting in Dec 2024 for other reasons should meet informally to discuss WG-32 plans. JH offered to organize an informal meeting for lunch or coffee at this conference. BB stated that he wanted to incorporate the WG-32 project into the International League Against Epilepsy (ILAE) Neurotechnology Section meeting at this AES conference. [BB is Co-Chair for this ILAE Section.] BB asked JH if he would be willing to give a short talk presenting the WG-32 project to the Section. JH agreed to do this.
- **WG-32 Fundraising.** JH stated that he is in process of sending out solicitations to neurophysiology original equipment manufacturers and pharmaceutical corporations (in the epilepsy and sleep medicine sectors) to support WG-32 operations by giving a donation to IFCN. JH reported that the president of IFCN had provided a letter for support for this round of solicitation and the IFCN Executive Committee had reviewed and approved a list of OEMs and pharmaceutical corporations to solicit.

5. NEW BUSINESS

- **LTM EEG and Sleep Monitoring IOD.** It was discussed that WG-32 will begin to develop an IOD for Long-term Monitoring (LTM) EEG and Sleep Monitoring. JH commented that SW had recently given an excellent presentation at a WG-32 ad-hoc teleconference last month on DICOM encoding of encapsulated data using photographic (JPEG) and video (MPEG) codecs. JH commented that DICOM appeared to have multiple mechanisms, including frames and fragments, that could be used to encode tables for indexing and the frames/fragments structure for blocking, although encoding of single-channel data (if WG-32 decided this was useful) could add an extra dimension of complexity. SW stated that she will begin preparing a Long-term Monitoring (LTM) EEG and Sleep Monitoring IOD Supplement document.

6. UPCOMING WG-32 FACE-TO-FACE MEETINGS

- None. We will have an informal meeting at the AES Conference in early December 2024 (<https://aesnet.org/AES-annual-meeting>). Details to follow.



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- DICOM WG-32 will also plan to meet in person at ICCN 2026 in Cartagena, Columbia.

7. DATE AND TIME OF NEXT MEETINGS

Thursday 19 September 2024	10:00- 11:00 am UD ET
Thursday 17 October 2024	10:00- 11:00 am UD ET

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