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MINUTES

MEETING NAME WG-32

MEETING PLACE/DIAL IN Via Zoom

DATE & TIME Thursday 19 June 2025
10:00– 11:00 AM Eastern Daylight Time (EDT)

PRESIDING OFFICERS Jonathan J. Halford,
Ralph H. Johnson VA Medical Center (Charleston, SC)
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
	Kevin	O'Donnell	Canon Medical Research USA, Inc.	Voting
	Felix	Rosenow M.D.	DGKN (German Society of Clinical Neurophysiology and Functional Imaging)	Voting
	Jan	Remi	Ludwig-Maximilians-University of Munich	Voting
x	Benjamin	Brinkmann	Mayo Clinic Rochester	Voting
x	Jonathan	Halford	Ralph H. Johnson VA Medical Center	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
	Raymond	Kraskinski	Philips	Observer
	David	Clunie	PixelMed Publishing	Voting
x	Silvia	Winkler	Sigma Software Solutions	Voting
	Ana	Alves	CortexXus Inc.	Observer
x	Giuseppe	Campobello	University of Messina	Observer
	David	Alves	CortexXus Inc.	Observer
	Babak	Razavi	CortexXus Inc.	Observer
	Matt	Stead	Dark Horse Neuro, Inc.	Observer
	Gritsch	Gerhard	AIT Austrian Institute of Technology GmbH	Observer
	Ignacio Ramírez	Paulino	Facultad de Ingeniería - Universidad de la República	Observer
	Sandor	Benizcky	Filadelfia	Observer
	Gardar	Thorvardsson	Kvikna / Stratus EEG	Observer

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	Richard	Moberg	Moberg Research, Inc.	Observer
	Casey	Stengel	Neuralynx	Observer
	Bill	Antilla	Nihon Kohden Corporation	Observer
x	Koichiro	Matsumoto	Nihon Kohden Corporation	Observer
	Andrey	Pirozhenko	Persyst	Observer
x	Shane	Poznikoff	Persyst	Observer
	Stefan	Rampp	University Klinikum Erlangen	Observer
	Dagmar	Krefting	University Medical Center Göttingen	Observer
	Gloria	Menegaz	University of Verona, Italy	Observer
x	Jonathan	Pfaff	Fraunhofer Heinrich Hertz Institute HHI	Observer
x	Gary	Sullivan	Dolby Labs	Observer
	Kristian	Bernard Nilsen	Oslo University Hospital	Observer
x	NS	Nagarajan	GE Healthcare	Observer
	Bruno	Monnerat		Observer
	Christof	Fersch	Dolby Germany	Guest
	Heidi-Maria	Lehtonen	Dolby Germany	Guest
X	Brian	Lee	Dolby Laboratories	Guest
x	Mattia	Galante		Guest

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

The meeting was called to order at 10:00 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 May 2025 meeting were reviewed, motion to approve by JH and seconded by SW.

5. OLD BUSINESS

- WG-32 Minutes Document Generation Process
  Jon Halford (JH) discussed the process of generating minutes for Working Group 32 (WG-32) teleconferences. JH reported that in the previous WG-32 telecon, there had been

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discussion about whether it was consistent with DICOM rules to make an audio recording of DICOM WG telecons for the purpose of assisting organizers in creating a minutes document. JH stated that it had recently been confirmed with DICOM leadership that participants of DICOM WG meetings cannot make audio recordings of the meetings, but that one digital audio recording of the meeting could be made by one of the meeting organizers, as long as this audio recording was only used to draft the Minutes document, and as long as this audio recording was deleted after a draft of this Minutes document was written. JH proposed that he will record WG-32 meetings on his iPhone, will draft the WG-32 Minutes document, and will delete the audio recording off of his iPhone once a Minutes document has been drafted. JH also stated that this digital audio recording would not be backed up to his iCloud account. JH stated that this plan was OK with Kim Zaiss (KZ), the Executive Director of IFCN, and it was going to be the WG-32 plan moving forward, unless a WG-32 participant voiced concerns. JH stated that if further concerns were voiced, there would be further WG-32 discussion on this topic. JH asked if there was any attendee at the telecon who had any concerns about this plan. No one voiced any concerns.

- Update on the ITU-T Call for Proposals (CfP) for Biomedical Waveform Coding

  Gary Sullivan (GS) reported that the next formal ITU-T Q6/SG-21 ("Technologies for multimedia, content delivery and cable television") meeting was going to be in approximately 1.5 weeks in Korea and that there was going to be an Ad-hoc meeting of Q6/SG-21 in around 15 hours. He reported that the deadline for submissions for contributions to this meeting was yesterday, and, so far, there were around 12 submissions. He reported that the submissions included experimental results and proposals for H.BWC codec refinement and that these all came from the same four companies who originally responded to the CfP: Dolby Labs, Fraunhofer HHI, Philips, and the Electronics and Telecommunications Research Institute (ETRI). He reported that it is anticipated that a new draft H.BWC standard will likely be produced by this meeting, which he anticipated to be a minor revision. Overall, he reported that the project is proceeding as expected, and July 2026 is being targeted for completion of standardization of the H.BWC codec. He also reported ongoing discussions between ITU-T SG-21 and ISO/IEC about making the H.BWC codec a joint ITU-T/ISO/IEC standard through Work Group 6 of the Joint Technical Committee 1, Sub-committee 29 (which is ISO/IEC JTC 1/SC 29/WG 6 "MPEG Audio coding").

  GS asked about whether the H.BWC codec would be expected to support biomedical waveform data which had bit depths beyond 16, and possibly beyond 24. He stated that support of bit depth beyond 24 could be a problem for SG-21, because it could require significant codec design changes. JH stated that Silvia Winkler (SW) had reached out to the neurophysiology OEM that had provided her with a "32 bit depth" recording of EEG waveforms and that, on further analysis, this data was found to be zero-padded 24 bit depth EEG data. JH stated that he did not think that WG-32 would request

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that the H.BWC codec support bit depths over 24, and asked SW and Ben Brinkmann (BB) if they agreed, and they said that they agreed. JH asked if there were any WG-32 telecon attendees who had any different opinions, and there were no other opinions voiced. BB added that he did not think that WG-32 could find biomedical waveform data anywhere which was encoded at bit depth 32 or higher.

GS asked about the inclusion of photoplethysmography (PPG) data as a reference dataset. BB stated that he had quite a bit of PPG data stored at his lab and thought that it was all encoded at max bit depth of 16 bit, but he said that he would double check on that. GS asked JP if SG-21 had PPG data and JP reported that they did have some PPG data, but PPG data was not listed as a data type with common test conditions in the H.BWC spec. JP stated that Philips had also expressed interest that PPG data be added as a reference dataset, and JP stated that he would reach out to Philips at their upcoming SG-21 meeting in Korea the following week to ask them about this. JH stated that a reference dataset of PPG data would be added to the research protocol.

Giuseppe Campobello (GC) brought up additional aspects of the codec design that he thought needed to be discussed beyond compression ratio and distortion level, including (1) the block size parameter, (2) the time required for encoding and decoding, and (3) the effect of waveform data being single-channel vs multi-channel. JP responded that, given that H.BWC was a hybrid codec which was highly parameterizable, the best approach to testing a lossy encoding could be to test the codec using the common test conditions for several reference datasets which were included in the H.BWC draft spec, using a few Quality Index values for each reference dataset. GC stated that his lab staff had begun using the H.BWC codec and were experimenting with various codec parameterizations. GC suggested that optimal input parameters to H.BWC might be quite different if the codec was applied to short epochs of data versus longer epochs, because if the first segment happened to contain an artifactual signal, instead of a biologically-generated waveform (which was more likely for short block sizes), this could adversely affect lossy codec performance-- so there was going to be a trade-off between the number of samples (block size) and codec performance. GS stated that he agreed, and also added that block size could be a pre-set input parameter to the encoder or it could be chosen by the encoder adaptively based on input signal characteristics. GS stated that SG-21's normal configuration was that the encoder chooses a block size, but that there would be an encoder setting which modulated the frequency of random-access points in the encoded signal (where it would be possible to begin decoding "from scratch"). GS stated that the frequency of these random-access points would affect what SG-21 called "coding efficiency", which was the bitrate needed to achieve a certain level of fidelity. He stated that SG-21 would rather that the codec be controlled primarily by the Quality Index parameter (in terms of the frequency and pattern of random-access points) rather than by specifying a fixed block length as a parameter. GS added that, similarly, SG-21 would expect that, rather than a user needing to change input parameters to the encoder based on whether the input data was single channel vs multichannel, that the H.BWC encoder

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itself would use the Quality Index parameter to choose a random access point distribution, based on whether the waveform data was single-channel vs multichannel, in order to maintain a specified level of fidelity. But GS stated that, at this stage in the project, the guidance for how we could select certain lossy parameterizations of the codec was limited, but that there was one proposal for how the Quality Index might be controlled which had been submitted for discussion at the upcoming SG-21 meeting.

- IOD for LTM EEG and Sleep Monitoring.
  JH stated that it was his understanding that what was needed to move forward with the development of this object was (1) H.BWC codec transfer syntaxes and (2) a plan for blocking and indexing using the H.BWC codec. SW agreed and proposed that she start drafting this Supplement using a transfer syntax for *lossless* H.BWC compression, which would be an easier first step. She also agreed that a plan for blocking and indexing for random access could be developed now. SW proposed that a later Supplement could add one or more transfer syntaxes for *lossy* H.BWC compression. JH stated that he thought this was a good plan and asked if there were any comments. JP stated that this sounded like a good plan, because it separated the issue of scientific development of lossy transfer syntaxes from the challenge of developing a plan for H.BWC random access points. SW agreed and added that the upcoming Supplement could also address whether random access points would be for all channels or if there could be random access points for individual channels. JP voiced strong agreement for this stepwise approach to developing this IOD.

- Intracranial EEG IOD.
  JH reminded attendees that a Work Item for the development of this IOD had recently been approved by the DICOM Standards Committee (DSC). JH added that WG-32 had previously decided on beginning to develop this Supplement now because this Supplement requires specification for how intracranial sources are encoded, which is challenging because there is no standard scheme source naming and intracranial EEG sources include not only stereo EEG (SEEG) with depth electrodes but also intracranial macroelectrode and microelectrode sources. SW stated that Stefan Rampp (SR) and JH had looked into useful ways to encode iEEG data and produced a document that she would be using to begin writing a new Supplement. She stated that the initial focus in writing this new Supplement would be creating the explanatory part, which she could bring to a first reading with WG-06, to start discussions with WG-06 about how encoding of these sources might work in DICOM objects. JH commented that there continued to be many open questions about the approach to encoding iEEG sources, such as whether we would attempt to encode data from microelectrodes. SW agreed that there were many open questions, but that we needed to begin the work of writing this Supplement so that we could determine what iEEG data could be encoded by DICOM.

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- WG-32 Fundraising
  JH reported that IFCN had one commitment for funds from one OEM and those funds were being transferred to IFCN. He also said that he is working KZ of IFCN and Andrew Ehrenberg to develop a financial model for WG-32 moving forward, since funds were needed to not only support administrative effort by IFCN and occasional travel to a clinical conference by SW, but also to support transfer syntax scientific research. JH reported that he had developed a document describing a financial model and he was discussing this document with Andrew Ehrenberg and KZ and would circulate this document to DICOM leadership, and if there was an agreement to an approach amongst these parties then he would circulate this document to WG-32 participants.

- Upcoming WG-32 Face-to-Face Meeting at ECCN2025
  JH reported that he was working to set up an informal one-hour meeting for participants of WG-32, or persons interested in the work of WG-32, in a conference room at the upcoming ICCN2025 conference in London during a coffee break time. KZ reported that she was working to confirm a time for this meeting with ECCN conference staff, and it might be over a lunch hour. JH stated that he would try to get the time for this meeting firmed up over the next few weeks, if possible. GC said that he could not attend because it was at a time of another conference for him. JH stated that was OK and this FTF meeting was not a formal WG-32 meeting anyway and would not replace one of the monthly WG-32 telecons, which would continue uninterrupted.

6. NEW BUSINESS

- Draft Research Proposal for Lossy H.BWC Transfer Syntax Development.
  JH stated that he was very excited about the progress of SG-21 toward standardizing the H.BWC codec and that WG-32 very much appreciated the collaboration with ITU-T. JH stated that it was the understanding of WG-32 that DICOM neurophysiology waveform data could not be encoded compressed until (1) there was a standardized codec available from ITU-T (H.BWC) and (2) a number of DICOM transfer syntaxes had been developed for the H.BWC codec. Transfer syntaxes would need to include a transfer syntax for lossless codec compression and at least one transfer syntax for lossy codec compression. He stated that, given the development of the transfer syntax for lossless compression would probably be relatively straightforward, a research plan was needed for the development of one or more transfer syntaxes for lossy compression. He reported that a draft research plan for H.BWC lossy transfer syntax development had been written, and feedback had been received from David Clunie of WG-06 and other WG-32 participants. He reported that David Clunie, the Editor of the DICOM Standard and member of both WG-06 and the DICOM Standards Committee (DSC), had provided excellent suggestions for document revisions and additions, including recommendations for a regulatory approach whereby an agreement could be drafted between the research organization administering the research project and archiving reference waveform datasets and entities (either

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government hospitals, university medical centers, and/or private companies) who contributed reference waveform datasets. JH reported that Stefan Rampp (SR) had provided excellent feedback from the standpoint of EEG/MEG clinical neurophysiology and that his feedback was being incorporated into the proposal. Kristian Bernard Nelson (KBN) had also provided excellent feedback from the prospective of neuromuscular waveform clinical neurophysiology and his feedback would also be incorporated.

JH asked a question to GS and Jonathan Pfaff (JP) of ITU-T SG-21: in the research proposal draft, from a broad perspective, the testing scenarios were conceptualized as a tensor of three dimensions: (1) type of reference dataset (routine EEG, intramuscular needle EMG, intracranial EEG, etc.) vs (2) bit depth [16 24] vs (3) H.BWC Quality Index. JH asked ITU-T telecon attendees if there were any other relevant parameters that would need to be considered besides bit depth and Quality Index. JP answered that the way H.BWC was designed, there were many different parameters that could be adjusted, but H.BWC is designed with the intension that the user would only adjust the Quality Index (which is also called the "quantization parameter"), and assumed that the user also used the SG-21 common test conditions parameters, which are part of the H.BWC draft document. JP reported that these H.BWC common test conditions parameters varied based on the type of waveform reference dataset. JP reported that the mapping between their quantization parameter and the Quality Index had not yet been fixed, and that this involved "step size". JH asked if "step size" referred to blocking and indexing, and JP responded that it did not, because "step size" for waveform codec design meant the interval between discrete quantization levels of waveform amplitude. JP stated that he assumed that we would want a higher Quality Index to mean lower quantization parameter (lower step size), which would also mean higher bit rate [and lower compression ratio]. JP stated that he would be happy to participate in this research and that Fraunhofer HHI had a large CPU cluster which could be used for distributed computing tasks. JH asked if JP and GS could offer suggestions as to which Quality Indexes would need to be tested. JP responded that if WG-32 gave SG-21 a target bitrate [which is loosely equivalent to a target compression ratio], SG-21 would not necessarily need neurologist expert opinion on signal quality to set H.BWC parameters for lossy compression. GS stated that he hoped that use of the Quality Index could guide the research plan, rather than bitrate. GS stated that SG-21 did need feedback from WG-32 at some point about whether certain lossy parameterizations of H.BWC (mainly Quality Index) were clinically acceptable, so SG-21 needed to continue to work on mapping H.BWC parameters, such as quantization level, to Quality Index. JH asked GS and JP to clarify if they did want expert opinion collected from neurologists at some point to validate the use of one or more DICOM transfer syntaxes, and they said that they did want this at some future point, once further development of H.BWC had occurred.

GS also requested a few minor changes to the research plan, including removal of any mention of ITU-T "SG-16" and replacing it with "SG-21" and naming his company correctly as "Dolby Laboratories Inc.".

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7. DATE AND TIME OF NEXT MEETINGS

Thursday 17 July 2025	10:00- 11:00 am UD ET
Thursday 21 August 2025	10:00- 11:00 am UD ET