TU Delft

Delft University of Technology

Document Version
Final published version

Citation (APA)
Halford, J. J., Campobello, G., Brinkmann, B. H., Stead, M., Rampp, S., Rémi, J., Nilsen, K. B., Dauwels, J., Galanti, M., & More Authors (2024). Letter to the Editor: Announcement of a Call for Proposals for biomedical waveform coding. *Clinical Neurophysiology*, *165*, 88-89. https://doi.org/10.1016/j.clinph.2024.06.010

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
In case the licence states “Dutch Copyright Act (Article 25fa)”, this publication was made available Green Open Access via the TU Delft Institutional Repository pursuant to Dutch Copyright Act (Article 25fa, the Taverne amendment). This provision does not affect copyright ownership.
Unless copyright is transferred by contract or statute, it remains with the copyright holder.

Sharing and reuse
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

This work is downloaded from Delft University of Technology.

Green Open Access added to TU Delft Institutional Repository

'You share, we take care!' - Taverne project

https://www.openaccess.nl/en/you-share-we-take-care

Otherwise as indicated in the copyright section: the publisher is the copyright holder of this work and the author uses the Dutch legislation to make this work public.

Clinical Neurophysiology 165 (2024) 88–89

Contents lists available at ScienceDirect

Clinical Neurophysiology

journal homepage: www.elsevier.com/locate/clinph

Letter to the Editor

Letter to the Editor: Announcement of a Call for Proposals for biomedical waveform coding

There is no well-accepted compressed coding format for biomedical waveform data such as electrocardiography (ECG), electroencephalography (EEG), and electromyography (EMG) signals. Current standard audio codecs, including MPEG-4 AAC (an ISO/IEC standard), are insufficient to serve as a codec for biomedical waveforms (Battaglia et al., 2024). There is a need for a new standard that can support efficient lossless and near-lossless compression and transmission targeted towards medical applications in the Digital Imaging and Communications in Medicine (DICOM®) organization and other standards bodies. Excellent performance has been achieved by some modern formats such as Multiscale Electrophysiology Format (MEF) (Brinkmann et al., 2009) and the related Multiscale Electrophysiology Data format. But these neurophysiology formats are not managed by an international standards organization and not designed to provide an encoded bitstream without metadata and without blocking/indexing information which can be implemented in a transmission standard such as DICOM. A new standard that can support efficient lossless and near-lossless compression and transmission specifically for biomedical waveform data is needed.

This Letter announces a Call for Proposals (CfP) on the coding of biomedical waveform data from the International Telecommunications Union (ITU), which is a United Nations Organization whose Telecommunication Standardization Sector (ITU-T) develops standards for information and communication technologies (ITU-T SG16 2024, issued for public release). The purpose of this CfP is to collect and evaluate coding technology which is targeted towards medical applications in DICOM and other organizations. It is hoped that standardization of compression for neurophysiology data transmission and storage in DICOM will make data widely available, exchangeable, interoperable, and independent of proprietary vendor-specific file formats. It is hoped that this will lead to a dramatic increase in the availability of big neurophysiology data sets which could facilitate, for example, identification of biomarkers in patients with various neurological diseases in the preclinical phase (Ziemann, 2023). It should be noted that this ITU specification, if standardized, may also address the needs for encoding of more general waveform signals (e.g. seismographic data or other types of non-imaging waveform signals).

The purpose of this CfP is to collect and evaluate coding technology for biomedical waveform data. Companies and organizations that have identified or developed such technology are invited to submit a response to this CfP. The submitted reference software should support lossy, near-lossless and lossless compression and have a mode where independent decoding of channels is supported. To evaluate a proposed compression technology, bit rates will be traded off against error measures. The objective error measures to be employed for initial evaluation of the compressed representations of the test data include maximum absolute error (Dauwels et al., 2013), percentage root mean square distortion, and peak signal-to-noise ratio. These error measures are not intended to be fully sufficient, and further study of the compression effect by neurophysiology experts will also be conducted. In a later stage, neurophysiology experts will evaluate whether data compressed by a proposed technology could have clinically relevant differences in comparison to the original data (Battaglia et al., 2024).

Companies and organizations that have identified or developed such technology are invited to submit a response to this Call. Descriptions of responses can be registered as input contributions to the Question 6/Study Group 16 (Q6/SG16) ITU-T meeting planned 30 October – 8 November 2024. Additional information submitted beyond the October/November 2024 meeting will also be considered. Participants who want to submit a response to this call, and are not currently ITU-T members, should contact the Q6/16 Rapporteur Gary J. Sullivan to request an invitation to participate in the October/November 2024 Q6/16 meeting. Remote participation access to the October/November 2024 meeting is also expected to be provided (on a best-effort basis). A full timeline with a list of deadlines is listed in the ITU-T CfP online (ITU-T SG16 2024, issued for public release).

Proponents are requested to submit a technical description of the proposed technology sufficient for full conceptual understanding and generation of equivalent performance results by experts to the meeting where the evaluation is performed. The patent policy for ITU-T is the same as for the ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission), found at https://www.iso.org/iso-standards-and-patents.html and https://www.itu.int/en/ITU-T/ipr/Pages/policy.aspx. The ITU, ISO and IEC are the largest international standards organizations, together comprising the World Standards Cooperation (WSC). The common patent policy of ITU-T/ISO/IEC refers to reasonable and non-discriminatory (RAND) terms, also known as fair, reasonable, and non-discriminatory (FRAND) terms, denoting a voluntary licensing commitment that standards organizations often request from the owner of an intellectual property right (usually a patent) that is, or may become, essential to practice a technical standard. Put differently, a F/RAND commitment is a voluntary commitment to the standard-setting organization (like ITU, ISO, IEC, or others) by the holder of standard-essential codec patents, of a willingness to license such patents under reasonable and non-discriminatory terms to any party that wishes to implement the standard. If a patent holder indicates they are not willing to make such a commitment, the policy states that a

https://doi.org/10.1016/j.clinph.2024.06.010
1388-2457/Published by Elsevier B.V. on behalf of International Federation of Clinical Neurophysiology.

standard will not be approved that requires the use of the patent (https://en.wikipedia.org/wiki/Reasonable_and_non-discriminatory_licensing). DICOM has a similar F/RAND policy established under section 9.5 of the DICOM Standards Committee Policies and Procedures (https://www.dicomstandard.org/about-home/governance) and requests a F/RAND policy for any novel codec standard that DICOM agrees to implement. It is the intention of ITU to develop a codec standard for biomedical waveforms under the described common patent policy.

Contacts for this CfP include: Jonathan Pfaff (CfP Coordinator and Chair of Q6/16 Ad-Hoc Group on Coding of Biomedical Waveform data), Gary J. Sullivan (Rapporteur Q6/16), Jonathan J. Halford (DICOM WG-32 User Co-Chair). Their email addresses are: jonathan.pfaff@hhi.fraunhofer.de; gary.sullivan@dolby.com; halfordj@musc.edu.

Conflict of Interest Statement

Coauthors Pfaff, Stead, and Sullivan are employed by companies that may respond to the Call described in this announcement and that may have or develop patent rights that could be relevant to the application.

Acknowledgement

This work was partially supported by the Veterans Affairs Office of Research and Development (I01HX003107-01A2), by the National Institute of Health and National Library of Medicine BIDS4Health research training program (T15LM013977), and by the European Union under the Italian National Recovery and Resilience Plan (NRRP) of NextGenerationEU, partnership on "Telecommunications of the Future" (PE00000001 – program "RESTART").

Appendix A. Supplementary material

The supplementary data to this article is the CnP document, as released by ITU-T in April 2024, that can be found online at https://doi.org/10.1016/j.clinph.2024.06.010.

References

Battaglia F, Galanti M, Gugliandolo G, Rampp S, Remi J, Parashos A, et al. Neurophysiology Signal Codecs for the DICOM® Standard: Preliminary Results. In: Presented at IEEE MeMeA2024 in Eindhoven, The Netherlands. June 2024.

Brinkmann BH, Bower MR, Stengel KA, Worrell GA, Stead M. Large-scale electrophysiology: acquisition, compression, encryption, and storage of big data. J Neurosci Methods 2009;180(1):185–92.

Dauwels J, Srinivasan K, Reddy MR, Cichocki A. Near-Lossless multichannel EEG compression based on matrix and tensor decompositions. IEEE J Biomed Health Inform 2013;17(3):708–14.

ITU-T SG16, Call for Proposals for a new ITU-T Recommendation H.BWC on the coding of biomedical waveform data. Rennes, France, 26 April 2024 (online, https://www.itu.int/en/ITU-T/studygroups/2022-2024/16/Documents/docs/CfP-H.BWC-TD-PLEN-0286-R1-Clean.pdf).

Ziemann U. Clinical neurophysiology: Quo vadis? Clin Neurophysiol: Off J Int Federation Clin Neurophysiol 2023;S1388–2457(23):00775.

J.J. Halford *
Departments of Neurology and Psychiatry, College of Medicine, Medical University of South Carolina, Charleston, SC, USA
Ralph H. Johnson Veterans Affairs Medical Center, Charleston, SC, USA
School of Computing, Clemson University, Clemson, SC, USA

* Corresponding author at: Department of Neurology, College of Medicine, Medical University of South Carolina, Charleston, SC, USA.
E-mail address: halfordj@musc.edu

G. Campobello
Department of Engineering, University of Messina, Messina, Italy
E-mail addresses: gcampobello@unime.it

B.H. Brinkmann
Departments of Neurology and Biomedical Engineering, Mayo Clinic, Rochester MN, USA
E-mail addresses: brinkmann.benjamin@mayo.edu

M. Stead
Dark Horse Neuro, Bozeman, MT, USA
E-mail addresses: matt@darkhorseneuro.com

S. Rampp
Departments of Neurosurgery and Neuroradiology, University Hospital Erlangen, Germany
E-mail addresses: stefan.rampp@uk-erlangen.de

J. Rémi
Department of Neurology, Ludwig Maximilians University, Munich, Germany
E-mail addresses: jan.remi@med.uni-muenchen.de

K.B. Nilsen
Section for Clinical Neurophysiology, Department of Neurology, Oslo University Hospital, Oslo, Norway
E-mail addresses: k.b.nilsen@medisin.uio.no

J. Dauwels
Department of Microelectronics, TU Delft, Delft, the Netherlands
E-mail addresses: j.h.g.dauwels@tudelft.nl

M. Galanti
Department of Public Health Sciences, College of Medicine, Medical University of South Carolina, Charleston, SC, USA
School of Computing, Clemson University, Clemson, SC, USA
E-mail addresses: mgalant@clemson.edu

B.C. Dean
Ralph H. Johnson Veterans Affairs Medical Center, Charleston, SC, USA
Department of Public Health Sciences, College of Medicine, Medical University of South Carolina, Charleston, SC, USA
School of Computing, Clemson University, Clemson, SC, USA
E-mail addresses: bcdean@clemson.edu

S. Winkler
Sigma Software Solutions OG, Vienna, Austria
E-mail addresses: silvia.winkler@sigmasoft.at

J.A. Ehrenberg
Nihon Kohden America, Irvine, CA, USA
E-mail addresses: Andrew_Ehrenberg@nihonkohden.com

J. Pfaff
Fraunhofer Heinrich Herz Institute (HHI), Berlin, Germany
E-mail addresses: jonathan.pfaff@hhi.fraunhofer.de

G.J. Sullivan
Director of Research and Standardization, Dolby Laboratories, San Francisco, CA, USA
E-mail addresses: gary.sullivan@dolby.com

Accepted 25 June 2024

Available online 2 July 2024