On Engagement with Open Source Software, Open Source Hardware, and Standard Setting: The Case of White Rabbit

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CCS CONCEPTS

• Hardware → Emerging technologies; **• Software and its engineering → Software development process management**; **Open source model**; **• Social and professional topics → Sustainability**; **• General and reference → Computing standards, RFCs and guidelines**.

KEYWORDS

Engagement, Open source software, Open source hardware, Standard setting, White Rabbit

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1 INTRODUCTION

Lock-in due to dependency on specific suppliers of proprietary technologies and services is a major challenge that can be avoided through use of open source software (OSS) [6] and open source hardware (OSH) [10]. There are a number of initiatives that utilise a combination of OSS and OSH, including the White Rabbit (WR) project [9]. This combination is attractive since it empowers organisations to be in control of their ICT solutions and through potential use of a variety of different suppliers creates conditions for avoiding lock-in and thereby provides opportunities for *long-term sustainable solutions*. Moreover, the relationship between OSS (and OSH) and standard setting has received increased attention in recent years and there is a need to better understand this relationship in different contexts [1, 2]. The WR project was initiated by CERN to address technical needs concerning "reliable, fast and deterministic transmission of control information in a network" with sub-nanosecond accuracy and picosecond precision [9] in scientific contexts. WR technology has been widely deployed in more than 30 scientific contexts in at least 17 different countries worldwide, which includes accelerators, synchrotrons, spallation sources, neutrino detectors, cosmic ray detectors, national time laboratories, and other applications [5]. Further, OSS and OSH developed in the WR project had a key role in standard setting for the latest edition of the Precision Time Protocol (IEEE 1588) standard [4] where accuracy and precision was vastly improved [8]. The WR project has also been described as one of several cases of "fruitful collaborations between standards and open source development" [1]. Altogether, this motivates WR as a relevant case for studying the interaction between OSS (and OSH) and standard setting. Organisational engagement can be considered an important aspect in assessing the long-term sustainability and diversity of OSS and OSH projects [3], and companies have early engaged strategically with OSS [7]. There is lack of studies that focus on organisational engagement in projects that combine OSS and OSH for concrete cases, and past studies focusing on WR mainly address technical aspects of the system. Hence, our study contributes to filling that knowledge gap and thereby contributes the first study on engagement with WR and its broader ecosystem which includes collaborative open projects encompassing OSS, OSH, and associated digital artefacts.

2 AIM

The ***overarching goal*** in this study is to characterise engagement with OSS, OSH, and standard setting in the context of the WR project and its broader ecosystem. Specifically, the study investigates

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the relationship between engagement with the WR project and standardisation activities in the context of the Precision Time Protocol (IEEE 1588) standard [4]. The investigation seeks to illustrate how standards can be developed and extended through open collaborative projects in the open hardware domain. This paper presents an overview of initial results concerning ***two principle contributions***. In a ***first part***, we characterise engagement with open collaborative projects in the broader WR ecosystem over time. In a ***second part***, we characterise the relationship between engagement with open collaborative projects in the broader WR ecosystem and standard setting in the context of the IEEE 1588 Standard.

3 METHOD

A case study of WR and its broader ecosystem is undertaken that involves analysis of data from public data sources relating software and hardware development activities in the broader WR ecosystem and standardisation activities related to IEEE 1588. Specifically, data sources include git repositories for open collaborative projects in the broader WR ecosystem, web pages related to WR and contributing organisations (for the first contribution), and in addition web pages and technical specifications related to standardisation activities related to IEEE 1588 (for the second contribution) and the role of WR in that context. A total picture of contributions over time related to authors' associated organisations, organisation types and associated headquarters locations was compiled. LinkedIn was the primary source for establishing organisation type and organisation headquarters.

4 RESULTS

Overall, initial results indicate that contributors to repositories in the broader WR ecosystem are part of a long-term sustainable community representing a diversified mix of different organisations and organisation types which have been engaged for more than a decade. CERN has been the most engaged organisation and has contributed to a clear majority of the WR repositories, provided a majority of the contributions, more than a third of all identified affiliated authors, and contributed during a total time span of 13 years. Further, there are long-term relations between engagement with open collaborative projects in the broader WR ecosystem and standard setting, where e.g. the coordinator of the WR standardisation effort at CERN (who also was co-chair for the High Accuracy subcommittee during the IEEE 1588-2019 standardisation process) has been engaged with a majority of the open projects in the broader WR ecosystem. There is also considerable and long-term interaction between the community that implements the Precise Time Protocol (IEEE 1588-2019) software stack (PPSI) and the broader WR ecosystem.

5 SUMMARY

Based on initial results from the study, we find that the diversified and long-term sustainable White Rabbit ecosystem has had a substantial impact, both in terms of its scientific contributions to White Rabbit technologies with wide and global adoption, and in terms of impact on standardisation and related activities in the context of IEEE 1588. Further, White Rabbit has created potential for extended business opportunities for hardware providers especially in light of IEEE standardisation. Extended engagement by organisations using White Rabbit is beneficial for maintaining momentum and promoting future sustainability of the White Rabbit ecosystem and technologies.

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REFERENCES

[1] Knut Blind and Mirko Boehm. 2019. The Relationship Between Open Source Software and Standard Setting. *EUR 29867 EN, JRC (Joint Research Centre) Science for Policy Report*, Nikolaus Thumm (Ed.). Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/163594

[2] Mirko Boehm and Davis Eisape. 2021. Standard Setting Organizations and Open Source Communities: Partners or Competitors? *First Monday* 26, 7 (June 2021). https://doi.org/10.5210/fm.v26i7.10806

[3] Jonas Gamalielsson and Björn Lundell. 2021. On Engagement With ICT Standards and Their Implementations in Open Source Software Projects: Experiences and Insights From the Multimedia Field. *International Journal of Standardization Research (IJSR)* 19 (2021), 1–28. Issue 1. https://doi.org/10.4018/IJSR.287102

[4] IEEE. 2019. *IEEE 1588-2019 - IEEE Standard for a Precision Clock Synchronization Protocol for Networked Measurement and Control Systems.* IEEE. https://standards.ieee.org/ieee/1588/6825/ Accessed: 2022-08-01.

[5] Maciej Lipiński, Erik van der Bij, Javier Serrano, Tomasz Włostowski, Grzegorz Daniluk, Adam Wujek, Mattia Rizzi, and Dimitris Lampridis. 2018. White Rabbit Applications and Enhancements. In *2018 IEEE International Symposium on Precision Clock Synchronization for Measurement, Control, and Communication (ISPCS).* IEEE, Piscataway, NJ, USA, 1–7. https://doi.org/10.1109/ISPCS.2018.8543072

[6] Björn Lundell and Jonas Gamalielsson. 2018. Sustainable Digitalisation Through Different Dimensions of Openness: How can lock-in, interoperability, and long-term maintenance of IT systems be addressed?. In *Proceedings of the 14th International Symposium on Open Collaboration* (Paris, France) *(OpenSym '18).* ACM, New York, NY, USA, Article 3, 10 pages. https://doi.org/10.1145/3233391.3233527

[7] Björn Lundell, Brian Lings, and Edvin Lindqvist. 2006. Perceptions and Uptake of Open Source in Swedish Organisations. In *Open Source Systems: IFIP Working Group 2.13 Foundation Conference on Open Source Software – The Second International Conference on Open Source Systems*, Ernesto Damiani, Brian Fitzgerald, Walt Scacchi, Marco Scotto, and Giancarlo Succi (Eds.). Springer US, Boston, MA, 155–163. https://doi.org/10.1007/0-387-34226-5_15

[8] Opher Ronen and Maciej Lipiński. 2015. Enhanced synchronization accuracy in IEEE1588. In *2015 IEEE International Symposium on Precision Clock Synchronization for Measurement, Control, and Communication (ISPCS)* (Beijing, China). IEEE, Piscataway, NJ, USA, 76–81. https://doi.org/10.1109/ISPCS.2015.7324687

[9] Javier Serrano, Pablo Alvarez, M Cattin, E. G. Cota, J Lewis, Pedro Moreira, Tomasz Włostowski, Georg Gaderer, Patrick Loschmidt, J Dedic, R Bär, T Fleck, M Kreider, C Prados, and S Rauch. 2009. The White Rabbit Project. In *Proceedings of ICALEPCS TUC004* (Kobe, Japan). ICALEPCS, 3 pages.

[10] Jiri Svorc and Andrew Katz. 2020. Breathe In, Breathe Out: How Open Hardware Licensing Can Help Save the World. *Journal of Open Law, Technology & Society* 11, 1 (2020), 49–56.