

Understanding the Technology Development Process at the Early Standardization Stage The Case of Cognitive Radio

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ABSTRACT

This research is aimed at developing a document content analysis method to be applied in studies of standardization and technology development. The proposed method integrates two theoretical frameworks: the co-evolutionary technology development framework and the “D-N-S” (Design, Negotiation, Sense-making) framework for anticipatory standardizing. At the backdrop of complex and diversified landscape of science and R&D efforts in the technology domain, and the repeated criticism of the weak link between R&D initiatives and standardization, it is argued that the method offered in this work helps to better understand the internal dynamics of the technology development process at the early stage of standardization or pre-standardization, which, in turn, can help mobilize and direct the R&D initiatives. To demonstrate the practical usefulness of the proposed method, this paper conducts a content analysis of the research contributions presented in the COST Action IC0905 “Techno-Economic Regulatory Framework for Radio Spectrum Access for Cognitive Radio/ Software Defined Radio” (COST-TERRA).

Keywords: *Anticipatory Standards, Cognitive Radio, Content Analysis, COST Action, Standardization, Technology Development*

1. INTRODUCTION

There is a general understanding and empirical evidence for the importance of standardization to economic development and regional competitiveness (Brykman 2011; DTI 2005; Blind 2004). Scholars agree that the (technology) standardization process is a complex phenomenon, and insufficiently understood

among businesses and politicians (Delaere and Ballon 2008; K. J. Lyytinen, Keil, and Fomin 2008; Isaak 2006; Bousquet, Fomin, and Drillon 2009; Jakobs 2003). Policy makers often call for standardization process improvements (European Commission 2007), specifically with regard to the repeatedly criticized “weak link” between standardization communities and R&D ones – the critique, which, among

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others, points at the lack of direct support by the European Community for early- and pre-standardization activities (Jakobs and Blind 2011). The growing complexities of Information and Communication Technologies (ICT) in general (Schneberger and McLean 2003) and ICT standards in particular (Delaere and Ballon 2008) aggravate the situation, which is referred to as “blurred ICT standardization landscape” (European Commission 2007; Jakobs and Blind 2011). The latter is also attributed to the lack of theoretical and practical understanding of the processes leading to the creation of standards. More often than not, development of a particular technology is advanced by several standards development organizations (SDOs) and/or consortia, whereas areas of standardization activities may be overlapping (Baldini et al. 2013). Thus, while focused, targeted efforts can help mobilize diverse R&D and standardization initiatives, the “blurred landscape” and the lack of tools or methods for “seeing through” makes it difficult for an observer to command the landscape view and hence to efficiently contribute to the technology and standards development.

An analysis of R&D activities directed at emerging technology (i.e., technology at an early or pre-standardization stage) can be helpful in informing the policy makers and standardization professionals on the research directions in general, and on “promising findings” of the research community in particular. Seeking to respond to the contemporary academic and practitioner challenges of the standardization domain, in this work we take a closer look at diverse research initiatives contributing to the development of a particular technology. These research initiatives at the early, pre-standardization stage of technology development constitute the *venue for trying and learning* through which immature technology gradually forms into a product(s) which can be successfully standardized and commercialized (Schot and Geels 2007; Schot, Hoogma, and Elzen 1994). An improved understanding of the R&D process and its topical content can not only contribute to establishing the links between similar activities in R&D and standardization

communities, but also strengthening existing links through the reduction of duplicate efforts, for example.

This paper makes a contribution by empirically examining discourses at the early stage of technology and standard evolution, which has been rarely done before (Nickerson and zur Muehlen 2006), and thereby helps better understand the dynamics and the content of the process. To fulfil on our goals, we choose an emerging technology called Cognitive Radio. CR/SDR¹ (Cognitive Radio / Software Defined Radio; hereafter referred to as Cognitive Radio (CR)) – a new generation for wireless communications, which carries a promise to overcome the existing limitations and imperfections of extant technologies in spectrum access and use.

Recognizing the importance of the wireless communications in general, and CR-enabled technologies in particular, many (if not all) major SDOs and relevant regulatory organizations have embarked on developing standards or defining norms and regulation for one or another aspect of CR-related telecommunications (Baldini et al. 2013; Arturas Medešis and Holland 2014). Such attention to the emerging technology by a large number of stakeholders contributes to the high level of diversification of development efforts, makes it difficult for researchers to locate and “connect” with relevant standardization organizations, and for the standardizers to “feed on” relevant and promising research projects.

The case examines the development of CR technology through the prism of European Science Foundation’s research networking programme “COST” (European Cooperation in Science and Technology), in specific COST Action IC0905 “Techno-Economic Regulatory Framework for Radio Spectrum Access for Cognitive Radio/ Software Defined Radio” (COST-TERRA)². Documentation produced under the COST-TERRA over the period of two years from 2010 to 2012 was collected, systematized and analyzed using a qualitative data analysis software package NVivo. COST is aimed at coordination of nationally-funded research on a European level, encouraging

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