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# Authentication approach using one-time challenge generation based on user behavior patterns captured in transactional data sets

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## Biographical sketch

**Kristian Skračić** received the master's degree in computing from the Faculty of Electrical Engineering and Computing, University of Zagreb, Croatia in 2012. His research interests include user authentication, network security and software engineering. He is working toward the PhD degree at the Faculty of Electrical Engineering and Computing, University of Zagreb. His main research interests include new user authentication methods. He is employed by Ericsson Croatia, where he is engaged in multiple research and development projects relating to user authentication and information security.

**Predrag Pale** received the MS and PhD degrees from the Faculty of Electrical Engineering, University of Zagreb, Croatia in 1988. He has been involved in both research and commercial projects since 1986, at the Faculty of Electrical Engineering, University of Zagreb. He is one of the founders of the Croatian Academic and Research Network.

**Zvonko Kostanjčar** received the Dipl. Eng. degrees in electrical and computer engineering and in financial mathematics from University of Zagreb. At the same University he received the Ph.D. degree in 2010. He is the recipient of the Roberto Giannini Teaching Award from the Faculty of Electrical Engineering and Computing, University of Zagreb. He is currently the President of the IEEE Signal Processing Society, Croatia Chapter. His main research activities include development of the statistical and machine learning methods for data analysis and complex systems modeling. He is currently working as an Assistant Professor at the University of Zagreb

## Abstract

Knowledge-based authentication methods have become increasingly popular, where they started as simple passwords, before evolving into static questions for fallback authentication and graphical password-based systems. Question-based authentication methods are typically based on static or slowly changing data sources, thereby making them vulnerable to eavesdropping, wiretapping, and other types of attacks. Thus, an alternative approach is needed to create an authentication challenge that could compete with other authentication factors: hardware tokens and biometrics. In this study, we propose a new authentication approach that exploits the user behavior patterns captured in non-public data sources to create unique, one-time challenges. We propose: (i) a model that is capable of representing user behavior patterns in a wide range of user activities captured from various data sources and (ii) a method for creating unique one-time challenges based on the model. We tested the model and the method based on multiple non-public data sources such as bank transactions, phone logs, computer usage data, and e-mail correspondence. We also demonstrated its efficacy with a live user pool. Security analysis indicated the full resilience of the proposed method against eavesdropping as well as its adaptability in response to guessing attacks by dynamically increasing the complexity of the challenge.

Keywords: user authentication; one-time challenge generation; user behavior profiling; transactional data sets patterns; Knowledge-based authentication; question-based authentication

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