

VI. ZAKLJUČAK

U ovom radu prikazana je analiza verovatnoće prekida u hibridnom komunikacionom sistemu u kojem se ista informacija nezavisno šalje RF linkom u prisustvu Nakagami- m fadinga i kooperativnim VLC/PLC linkom do prijemne antene sa SC kombajnerom.

Na osnovu dobijenih numeričkih rezultata može se zaključiti da najveći uticaj na smanjenje verovatnoće prekida ima povećanje srednjeg SNR-a na bilo kojoj od prenosnih deonica u sistemu. Značajan uticaj ima i dubina fadinga u radio kanalu (povećanje parametra m Nakagami- m fadinga). Smanjenje ugla zračenja ili visine LED lampe u odnosu na poziciju korisnika, smanjuje verovatnoću prekida, a povećanje visine posle neke izvesne vrednosti nema uticaj na dalju promenu verovatnoće prekida.

Dalji pravac istraživanja u ovoj oblasti bi bio na temu poboljšanja bezbednosti komunikacije na fizičkom nivou analiziranog telekomunikacionog sistema u slučaju jednog ili više prisluškivača.

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LITERATURA

- [1] J. A. Stankovic, "Research directions for the Internet of Things," *IEEE Internet Things J.*, vol. 1, no. 1, pp. 3-9, Feb. 2014.
- [2] S. Mudriievskiy "Power line communications: state of the art in research, development and application," *AEU – Int J Electron Commun.* Vol. 68, no. 7, pp. 575-577, 2014.
- [3] S. Sheoran, P. Garg, and P. K. Sharma, "Interference mitigation technique with coverage improvement in indoor VLC system," *Trans. Emerg. Telecommun. Technol.*, vol. 30, no. 2, p. e3511, Feb. 2019.
- [4] Z. Ghassemlooy, L. N. Alves, S. Zvanovec, and M. Khalighi, *Visible Light Communications: Theory and Applications*, 1st ed. Boca Raton, FL, USA: CRC Press, 2017.
- [5] D. A. Basnayaka and H. Haas, "Design and analysis of a hybrid radio frequency and visible light communication system," *IEEE Trans. Commun.*, vol. 65, no. 10, pp. 4334-4347, Oct. 2017.
- [6] A. Gupta, N. Sharma, P. Garg, and M. S. Alouini, "Cascaded FSO-VLC communication system," *IEEE Wireless Commun. Lett.*, vol. 6, pp. 810-813, Dec. 2017.
- [7] X. Ma, J. Gao, F. Yang, W. Ding, H. Yang, and J. Song, "Integrated power line and visible light communication system compatible with multi-service transmission," *IET Commun.*, vol. 11, no. 1, pp. 104-111, Jan. 2017.
- [8] W. Gheth, K. M. Rabie, B. Adebisi, M. Ijaz, G. Harris, "Performance Analysis of Integrated Power-Line/Visible-Light

Communication Systems with AF Relaying," 2018 IEEE Global Communications Conference (GLOBECOM), Abu Dhabi, United Arab Emirates, United Arab Emirates, 9-13 Dec. 2018.

- [9] W. Gheth, K. M. Rabie, B. Adebisi, M. Ijaz, G. Harris, "On the Performance of DF-based Power-Line/Visible-Light Communication Systems," 2018 International Conference on Signal Processing and Information Security (ICSPIS), DUBAI, United Arab Emirates, United Arab Emirates, 7-8 Nov. 2018.
- [10] M. Jani, P. Garg, A. Gupta, "Performance Analysis of a Co-Operative PLC/VLC System with Multiple Access Points for Indoor Broadcasting," *AEU International Journal of Electronics and Communications*, vol. 103, pp. 64-73, May 2019.
- [11] Y. H. Ma, P. L. So, E. Gunawan, "Performance analysis of OFDM systems for broadband power line communications under impulsive noise and multipath effects," *IEEE Trans. Power Del.*, vol. 20, no. 2, pp. 674-682, Apr. 2005.
- [12] I. M. Kostic, "Analytical approach to performance analysis for channel subject to shadowing and fading," *IEE P-Commun.*, vol. 152, no. 6, pp. 821-827, 9 Dec. 2005.
- [13] I. S. Gradshteyn, I. M. Ryzhik, *Table of Integrals, Series, and Products*. 6th ed., New York: Academic, 2000.
- [14] A. P. Prudnikov, Y. A. Brychkov, O. I. Marichev, and G. G. Gould, *Integrals and Series. Volume 3, More Special Functions*, 1st ed. Amsterdam, The Netherlands: Gordon Breach Sci., 1986.
- [15] T. Komine and M. Nakagawa, "Fundamental analysis for visible-light communication system using LED lights," *IEEE Trans. on Consum. Electron.*, vol. 50, no. 1, pp. 100-107, Feb. 2004.

ABSTRACT

In this paper, a hybrid communication system with an end-user node for indoor broadcasting is considered. A cooperative power line communication (PLC) and visible light communication (VLC) links, connected by the decode-and-forward (DF) relay, are used for a signal transmission. As a back-up, an independent RF wireless channel is also used for transmission of the same signal. A user node's receiver utilizes selection combining (SC) method to choose a branch with higher signal quality. In this work, the outage probability is analysed and the impact of various PLC, VLC and RF link parameters on the system performance are assumed. In more details, the impact of LED lamp's position (the distance and the semi-angle), the average signal-to-noise-ratio (SNR) of the PLC, VLC or RF link, fading severity and the outage threshold impacts on the outage probability of the system under consideration is investigated.

Outage probability analysis of a hybrid RF – VLC/PLC communication system

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