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An experimental investigation into high bandwidth wireless communication standards for the underground mine stope

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Abstract

There are many challenges associated with developing a feasible wireless communication system for the harsh underground mining environment. Radio signals suffer from strong attenuations due to the excessive reflections, diffractions, scatterings, and multipath caused by the irregular surface characteristics of the stope. This necessitates the need for a robust underground mine wireless communication network that can withstand these phenomena. The network will still need to provide enough bandwidth for productivity enhancement applications as well as maintain low latency alongside robustness for critical mine safety applications. Coded OFDM (COFDM) was identified as the wireless standard for dealing with the harsh mining environment. However, due to the standard not being mainstream, the implementation of such a system will be extremely expensive. This research identifies the possibility of utilising Wi-Fi6 (802.11ax) which utilizes Orthogonal Frequency Division Multiple Access (OFDMA) as a more cost-effective alternative as compared to COFDM. Experimental investigations for comparing COFDM and Wi-Fi6 have been conducted in terms of latency, jitter and throughput measurements in several different topology and configurations. The uncoded Wi-Fi6 was found to be quite capable for high bandwidth productivity enhancement applications for the stope at an economical price point as compared to the more robust COFDM. Hence the more expensive COFDM should only be deployed for the critical mine safety applications.