

ABSTRACT

Railway telecommunications systems are fundamental to the safety, reliability, and efficiency of train operations. At PT Kereta Api Indonesia (Persero) (KAI), the Radio Train Dispatching system supports critical voice communication between operation control centres, train drivers, and station signallers. However, the existing transmission infrastructure is based on a legacy Time Division Multiplexing (TDM) system, which provides limited redundancy and scalability. Historical failure data indicate that this system has no redundancy to mitigate failure, potentially causing operational disruptions and increasing safety risks. This study aims to improve the Reliability, Availability, Maintainability, and Safety (RAMS) performance of the train dispatching telecommunication system through the implementation of a redundant Internet Protocol (IP)-based transmission network utilising existing fibre optic and microwave radio links. Network redundancy is achieved through the implementation of Rapid Spanning Tree Protocol (RSTP), while existing analogue radio equipment is integrated into the IP-based network using Radio over Internet Protocol (RoIP).

This research adopts a case study approach conducted at PT KAI, Regional Division I North Sumatra. The methodology involves analysing secondary data of equipment failure records from 2020 to 2024 obtained from the SINTELIS department to evaluate the RAMS performance of the existing system, including Mean Time Between Failures (MTBF), Mean Time to Repair (MTTR), Availability, and Safety. The proposed network architecture is then simulated using Cisco Packet Tracer, and the recovery time of simulated failure scenarios is analysed to evaluate improvements in RAMS performance compared with the existing system. Benefit Cost Analysis is done using Net Present Value (NPV), Payback Period (PP), and Benefit Cost Ratio (BCR).

The results indicate significant improvements in system RAMS performance. Simulation results shows average MTTR of 2 seconds during failure scenarios on proposed system, compared with approximately 148 minutes (8,880 seconds) in the existing system, which improve system Reliability (MTBF), Availability, Maintainability (MTTR), and Safety. The results also indicate that the proposed solution is economically viable by NPV, PP, and BCR parameter.

Keywords: Traindispatching, Reliability, Availability, Mantainability, Safety, Redundancy.