

## Reliability and Availability Analysis of Satellite Data Reception System using Reliability Modeling

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**Abstract :** System reliability and system availability evaluation plays a crucial role in ensuring the seamless operation of complex satellite data reception system with consistent performance for longer periods. This paper presents a novel approach for the same using a case study on one of the antenna systems at satellite data reception ground station in India. The methodology involves analyzing system's components, their failure rates, system's architecture, generation of logical reliability block diagram model and estimating the reliability of the system using the component level mean time between failures considering exponential distribution to derive a baseline estimate of the system's reliability. The model is then validated with collected system level field failure data from the operational satellite data reception systems that includes failure occurred, failure time, criticality of the failure and repair times by using statistical techniques like median rank, regression and Weibull analysis to extract meaningful insights regarding failure patterns and practical reliability of the system and to assess the accuracy of the developed reliability model. The study mainly focused on identification of critical units within the system, which are prone to failures and have a significant impact on overall performance and brought out a reliability model of the identified critical unit. This model takes into account the interdependencies among system components and their impact on overall system reliability and provides valuable insights into the performance of the system to understand the Improvement or degradation of the system over a period of time and will be the vital input to arrive at the optimized design for future development. It also provides a plug and play framework to understand the effect on performance of the system in case of any up gradations or new designs of the unit. It helps in effective planning and formulating contingency plans to address potential system failures, ensuring the continuity of operations. Furthermore, to instill confidence in system users, the duration for which the system can operate continuously with the desired level of 3 sigma reliability was estimated that turned out to be a vital input to maintenance plan. System availability and station availability was also assessed by considering scenarios of clash and non-clash to determine the overall system performance and potential bottlenecks. Overall, this paper establishes a comprehensive methodology for reliability and availability analysis of complex satellite data reception systems. The results derived from this approach facilitate effective planning contingency measures, and provide users with confidence in system performance and enables decision-makers to make informed choices about system maintenance, upgrades and replacements. It also aids in identifying critical units and assessing system availability in various scenarios and helps in minimizing downtime and optimizing resource allocation.

**Keywords :** exponential distribution, reliability modeling, reliability block diagram, satellite data reception system, system availability, weibull analysis

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