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### 基于传输性能降级约束的机载网络可靠性研究

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#### Study on Network Reliability in Avionics Based on Performance Degradation Constraints

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**摘要** 为提高因出现故障而导致网络设备资源不足时机载网络的可靠性,定义了两种机载网络传输性能降级约束,降级约束使用3个参数精确描述机载网络中消息实例传输成功或失败的数量及其分布。提出动态失效、关键函数和最小确定性将来序列等概念来对网络传输性能降级约束进行理论分析;通过计算关键函数值预先确定下一条消息实例传输失败是否会产生动态失效;使用最小确定性将来序列确定在不发生动态失效时将来消息实例传输成功的最少数量。给出两种实施约束的策略:消息源节点静态过滤和网络动态仲裁。提出一种适用于网络动态仲裁策略的调度算法:基于网络传输性能降级约束的双层优先级调度,该算法利用关键函数的预判性来避免动态失效;分析了该算法的可调度性条件。理论分析和仿真表明,当机载网络设备资源不足时,通过实施网络传输性能降级约束可以把网络性能降级的程度限制在可控范围内,从而增强机载网络的可靠性。

**关键词:** 航空电子 可靠性 网络性能 降级 可调度性分析 动态失效

**Abstract:** In order to enhance network reliability in avionics when there is a shortage of network equipment due to malfunction, two performance degradation constraints are defined. Both degradation constraints employ three arguments to accurately describe the number and distribution of message failures or successes during transmission. New concepts, such as dynamic failure, critical function and minimal guaranteed future sequence, are defined to analyze the performance degradation constraints: the value of critical function can predict whether a dynamic failure will occur if the transmission of the next message fails; the minimal guaranteed future sequence can minimize the number of successful transmissions without the occurrence of dynamic failure. Two strategies are proposed to implement the performance degradation constraints in avionic networks: static filtration by message source and dynamic arbitration by network. A double-layer priority scheduling algorithm is proposed, which is based on performance degradation constraints and used in the strategy of dynamic arbitration by network. The algorithm is able to avert dynamic failure by means of the predictability of critical function. The schedulability of the algorithm is also analyzed. The analysis and simulation proves that the network reliability in avionics is improved by implementing the performance degradation constraints.

**Keywords:** avionics reliability network performance degradation schedulability analysis dynamic failure

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