ABSTRACT

RELIABILITY ANALYSIS OF A PROCESSING SYSTEM IN COMPUTER NETWORKS

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Computer network systems are being recently used in companies, research institutes and universities as remarkable advances are made in information industries. The system has advantages in the following points:

(i) To use and keep information resources such as programs and data in common.

(ii) To share the work with one another.

(iii) To improve reliability.

In particular, the system with high reliability have been required from security, reliability, and economics of information resources.

This paper considers a model of multi-processor systems in which one of systems fails, it is supplemented by other systems. That is, the system is consisted of two processors. If either of the two processors fails, the system asks the central computer for back-up and undergoes repair apart from other systems. It is assumed that the work of the failed system is shared wholly among other systems. Thus, a system failure occurs when two processors are down simultaneously during the time interval spent in asking for back-up.

The model forms a Markov renewal process. Thus, by using the technique of Markov renewal processes, we have the following results:

The steady-state unavailability is

$$\frac{\sum_{n=1}^{2}\int_0^\infty\int_u^{u+l} F_{3-n}(t)\,dt\,dF_n(u)-l}{l+\frac{1}{\mu_1}+\int_0^\infty \bar{F}_1(u)\,\bar{F}_2(u)\,du-\left(\frac{1}{\mu_2}-\frac{1}{\mu_1}\right)\left[1-\sum_{n=1}^{2}\int_0^\infty F_{3-n}(u+l)\,dF_n(u)\right]}$$

The mean time to system failure is

$$\frac{\sum_{n=1}^{2}\left[\int_0^\infty\int_u^{u+l} t\,dF_{3-n}(t)\,dF_n(u)+\int_0^\infty\left(u+l+\frac{1}{\mu_1}\right)\bar{F}_{3-n}(u+l)\,dF_n(u)\right]}{\sum_{n=1}^{2}\int_0^\infty F_{3-n}(u+l)\,dF_n(u)-1}$$

The expected number of system failure is

$$\frac{\sum_{n=1}^{2}\int_0^\infty F_{3-n}(u+l)\,dF_n(u)-1}{l+\frac{1}{\mu_1}+\int_0^\infty \bar{F}_1(u)\bar{F}_2(u)\,du-\left(\frac{1}{\mu_2}-\frac{1}{\mu_1}\right)\left[1-\sum_{n=1}^{2}\int_0^\infty F_{3-n}(u+l)\,dF_n(u)\right]}$$

Here, $F_i(t)$ $(i = 1, 2)$ is the failure time distribution of the processors, $1/\mu_1$ and $1/\mu_2$ are the mean repair times for the respected cases where one or two processors have failed, l is the time spent in asking for back-up, and $\bar{F} = 1 - F$.

A numerically example is finally presented when the failure time is gamma with order 2.