TECHNISCHE UNIVERSITÄT
CHEMNITZ

Professur
Betriebssysteme

3. Excercise

Dependable Systems

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Task 1

Theoretical Questions:

a) Define fault tolerance and fault intolerance for system design. What is the relationship between the two?

b) How do we tolerate faults in the system?

c) What types of redundancy do you know?

d) Give an example for a each type of redundacy that you mentioned.

e) Think of the backward recovery. Try to make a rough analysis of the timing of a faulty behavior. What run times are possible? Try to quantify the timely behavior in the worst case. What implications would it have for the system?

f) Describe the functional principle of a TMR. Think of the properties/tasks that a voter module should posess/be able to solve.

g) What metrics for describing a fault-tolerant system can you think of? Why do we need them in the first place?

Task 2

The satellite moving on its orbit can experience communication problems. The number of such faults per month is a Poisson-distributed random variable with the probability mass function $\dfrac{e^{-5}5^k}{k!}$. Through usage of backup communication bus the satellite can get back online within 1 minute. Find the average availability A of the satellite per year.

Task 3

The reliability in a TMR system is $R_M = 0.9$ for each of the modules. What is the minimum reliability of the voter in order to achieve a reasonable application of TMR?

Task 4

A research space probe has a MTTF of 3000 hours. Calculate the mission time on the level $R(t) = 0.97$. Discuss on the meaning of the obtained result.

Task 5

A computer system is composed of a mainboard, a power supply and a memory subsystem. On the mainboard, there is a CPU, volatile memory and IO-Unit. All units need to function. The power supply is implemented with redundancy. It consists of two UPSs and an auxiliary supply. At least one power supply must function. The RAID system consists of four disks out of which three need to work properly. The respective MTTFs are given in the figure.
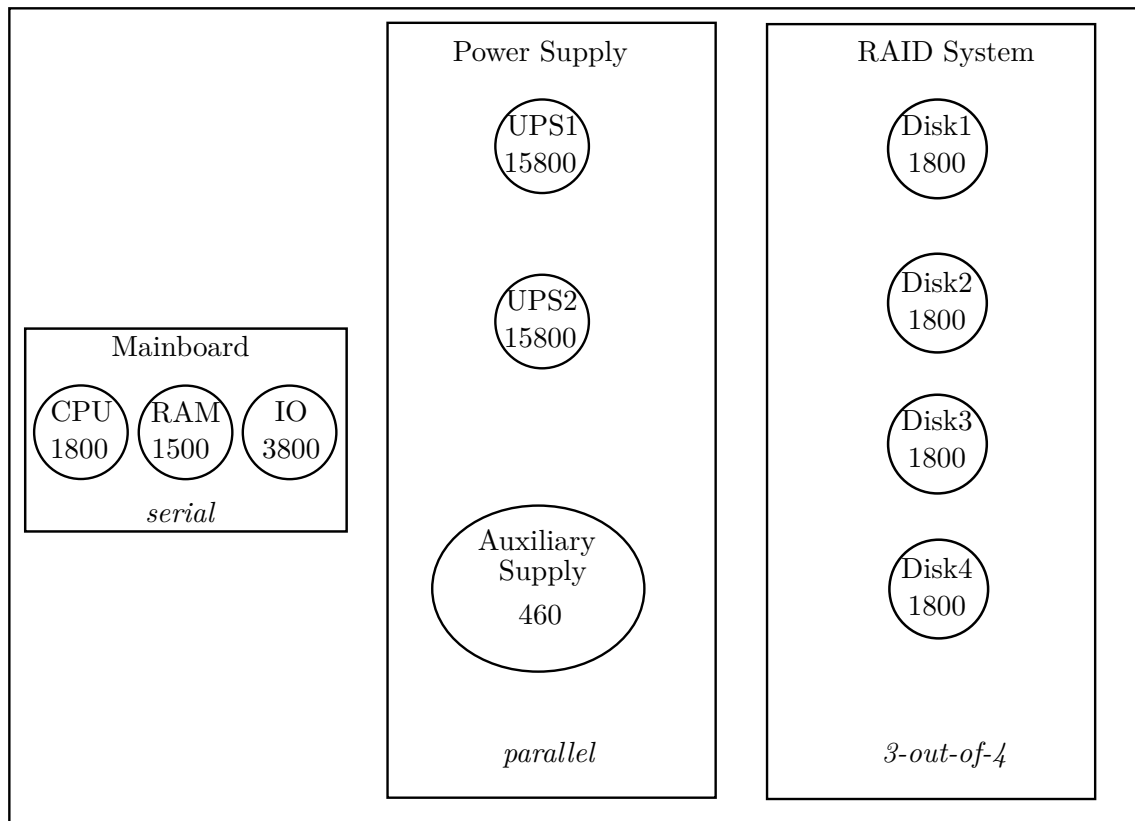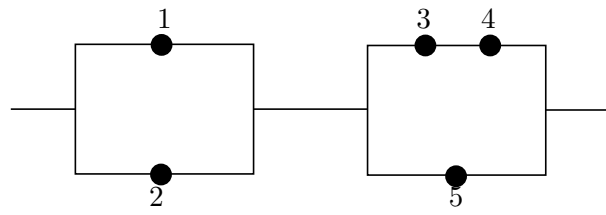
a) What is the MTTF of the mainboard?

b) What is the MTTF of the power supply?

c) What is the MTTF of the RAID subsystem?

d) What is the overall MTTF of the whole system?
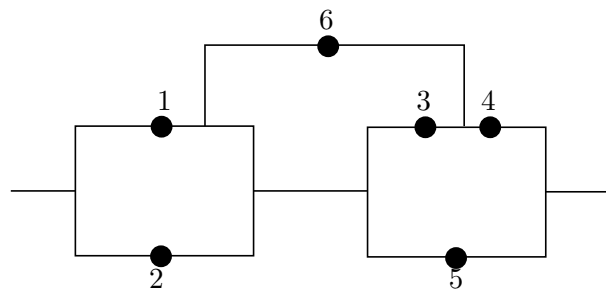
Task 6

Compute the resulting reliability of the whole system. $R_1 = 0.9, R_2 = 0.9, R_3 = 0.99, R_4 = 0.99, R_5 = 0.87, R_6 = 0.99$

a) System 1:

b) System 2:

Literatur

[1] Ronald Meester - A Natural Introduction to Probability Theory. 2008 Birkhäuser Verlag.

[2] Hwei Hsu - Theory and Problems of Probability, Random Variables, and Random Processes. Schaum's Outline Series