

Dependable Systems

SS 2012

Assignment 3

(Submission deadline: July 8th 2012, 23:59 CET)

Petri Net Modeling

In this assignment, it is your task to perform an availability analysis based on a petri net state model. You can use the petri net tool of your choice (<http://bit.ly/mvdzeo>). It needs to support inhibitor edges in timed petri nets. We recommend to use TimeNET by Prof. Dr. Armin Zimmermann, which is available for Windows and Linux. In case of TimeNET, use the „eDSPN“ net type for your solution. The tool can be downloaded with the password from the lecture from the BlockSim folder.

Please submit your written solution report as PDF document (no ZIP, no RAR, no native modeling files) at:

<https://www.dcl.hpi.uni-potsdam.de/dependassign/>

The System Setup

It is your task to analyze the availability behavior of a tiny data center environment. It consists of 45 servers that run in a redundant setup, providing services for the customer. 5 additional servers are used as cold standby backup. Due to power supply and cooling restrictions in the tiny data center building, no more than 45 servers should run at the same time. If less than 45 run, the data center is assumed to be broken, since performance level agreements are violated.

There are two administrators capable of performing repair activities, Jens and Ralf. Both can only repair one machine at a time. Jens needs on average 48 hours for one machine, while Ralf needs 96 hours on average. Bringing a cold spare machine to life is only possible by an explicit activation step that takes 1 hour on average. Jens and Ralf can do this in parallel to their normal work, since the complete process works in an automated fashion (software image deployment, unattended install support). Both give their best to operate the center always at maximum performance. If there is something to repair, they do not sleep or eat.

Since all servers were bought from ‚Dall‘ company, they have the same failure rate. On average, any of the machine breaks once per week. At maximum, one machine breaks at a time. All stochastic processes in this exercise follow the exponential distribution.

Model the petri net that describes the given conditions, and add it to your written report. Assume 45 machines as running and 5 machines in the spare pool in the start configuration. Answer the question by the help of your simulation.

Task 3.1. (mandatory)

What is the availability of the data center ? Explain the formula in relation to your petri net.

Task 3.2. (mandatory)

If each working machine can handle 1000 requests per hour on average, what is the average throughput of the system ? Explain the formula in relation to your petri net.

Task 3.3. (mandatory)

Rank the following options that may help in increasing the data center availability. Explain for each option how it can be reflected in the petri net model.

- (A) Increase the number of cold spares.
- (B) Extend the data center building for larger capacity, which would lead to more servers running in parallel and less cold spares.
- (C) Decrease the minimum number of running servers needed for normal operation (better software redundancy technologies)

Task 3.4. (mandatory)

What is the effect of reducing the cold spare activation time from 1 hour to 10 minutes ? Explain !

Task 3.5. (mandatory)

What is the effect of having zero spares and 45 running servers in the initial marking ? Explain !

Task 3.6. (mandatory)

Assume Jens is going on vacation, and some students are temporally hired as a replacement. Each of the students needs the double amount of time to perform the same work, so two of them are hired. Each them works for himself. What is the influence on availability ? Explain the result.