

Approximate Availability Analysis of VAXCluster Systems



Oliver Ibe, Richard Hove, Kishor Trivedi

Presented By

Neeraj Krishnan

CS 553, Spring 2003

Authors



Ibe and Howe used to work for Digital, and have worked on stochastics, petrinets, etc.

Professor Trivedi, decades of research on fault tolerance and analysis.

Ibe and Trivedi are now applying these techniques to broadband and wireless networks

What we'll do



Faults in VAXClusters

Traditional Markov Process Model

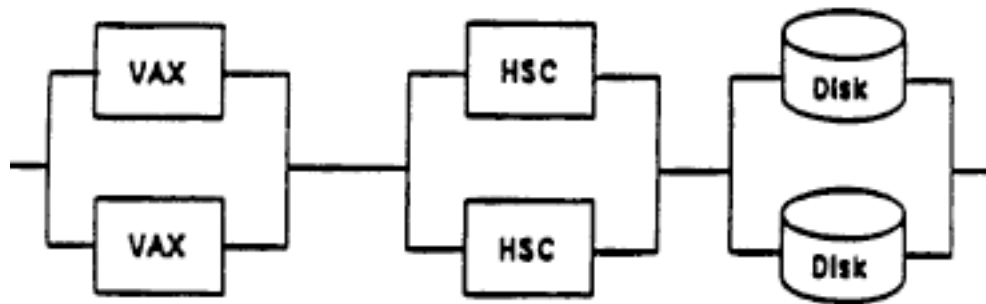
Decomposition based model

Availability

Optimal number of processors

Conclude

VAXCluster



Types of Faults



Processor: Permanent and Intermittent faults. Those that require repair and those that require reboot.

Cluster: Covered and uncovered. Those that don't require a restart and those that do.

Quorum

Exponential arrival rates

Modeling

As a Markov Process (continuous markov chain)

States (processors up or down)

Transitions, Rates (faults, recoveries)

Notation:

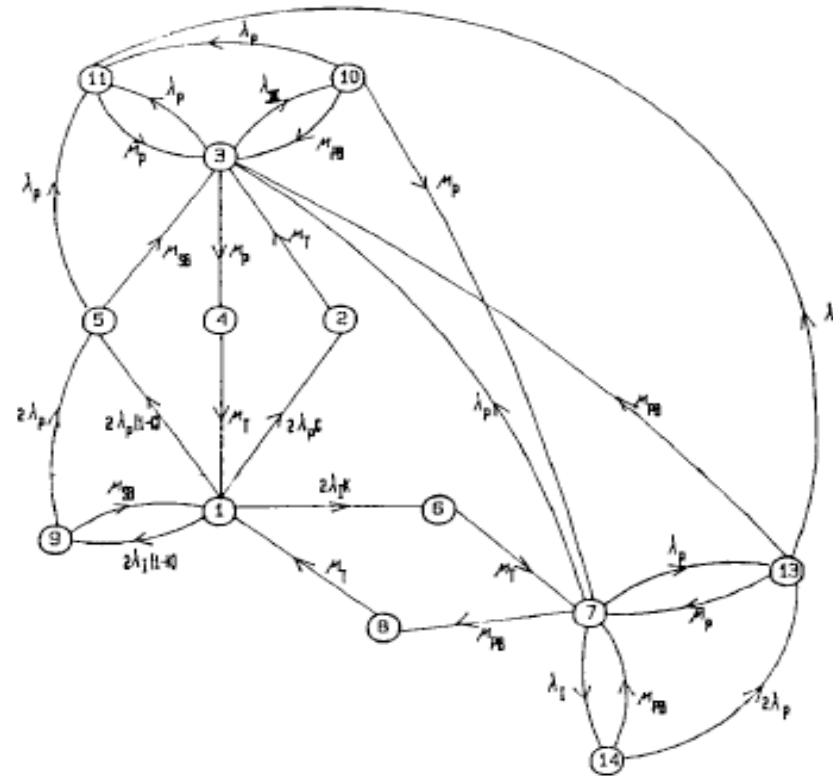
$1/\lambda_p, 1/\lambda_I$

$1/\lambda_p, 1/\lambda_{PB}, 1/\lambda_{SB}, 1/\lambda_T$

C, k

A_i, P_i

2-processor model



Lets build this. It blows up for three processors!

Decomposition



Main idea of paper !

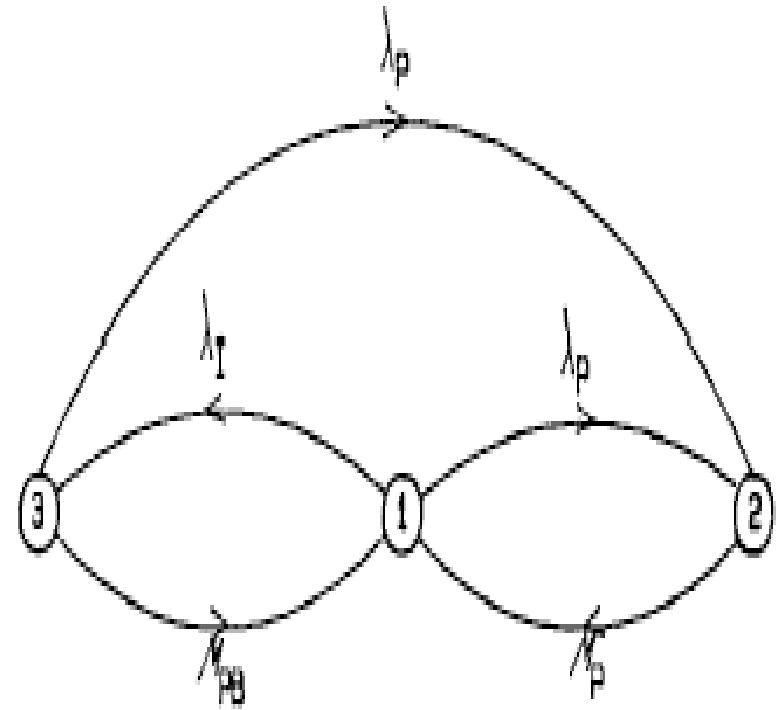
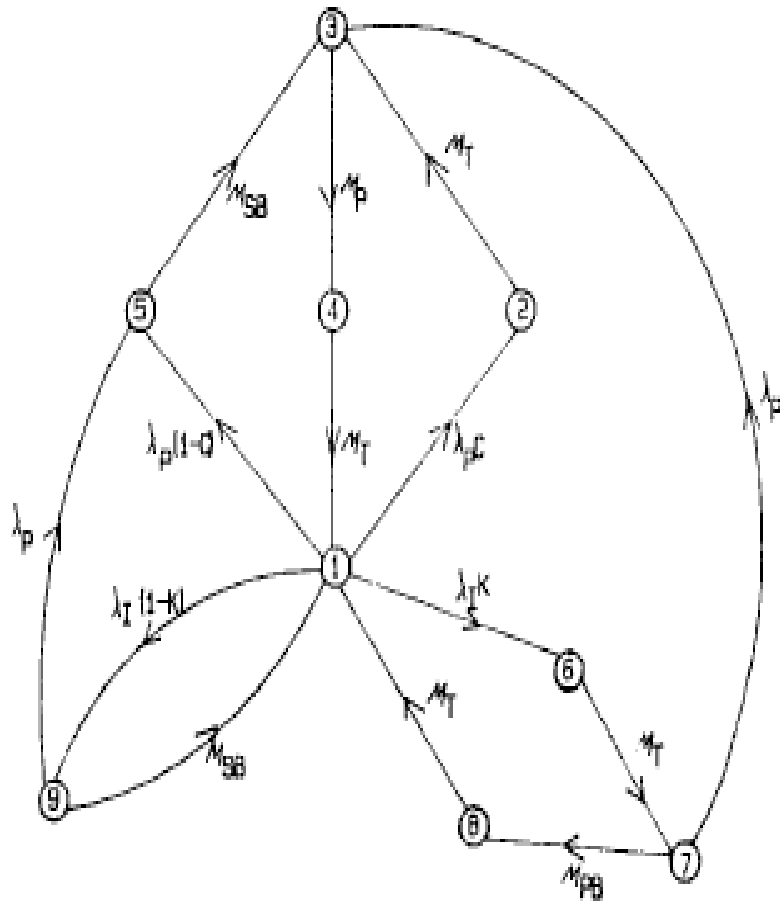
Model each processor independently.

What are the assumptions ?

Quorum not lost and

$MTBF > MTTR$

Decomposition



3 state model



X: set of states in which processor is up

Y: set of states in which cluster is down due to interference from processor

Z: set of states in which processor is down but cluster is up, given that a quorum is formed

Notation:

P_x, n_x, n_y, n_z

Availability



1 out of n

And whats the optimal n?

l out of n

And whats the optimal n ?

Availability

Steady state

How do we arrive at steady state probabilities for Markov Processes ?

4 nines, 5 nines etc.

$1/\lambda_P = 5000$ hours, $1/\lambda_I = 2000$ hours.
 $1/\mu_P = 2$ hours, $1/\mu_T = 30$ seconds.
 $1/\mu_{PB} = 6$ minutes, $1/\mu_{SB} = 10$ minutes.

Availability Predictions at $n = 3$

c	k	A_{exact}	A_{apprx}
0.90	0.90	0.9999326	0.9999330
0.90	0.94	0.9999416	0.9999420
0.94	0.90	0.9999364	0.9999368
0.94	0.94	0.9999454	0.9999458