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/ \( \mu_p \), 1/ \( \mu_{PB} \), 1/ \( \mu_{SB} \), 1/ \( \mu_T \)

\( C, k \)

\( A_i, P_I \)
2-processor model

Let's 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:

Px, nx, ny, nz
Availability

1 out of n

And what's the optimal n?

1 out of n

And what's the optimal n?
**Availability**

**Steady state**

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

4 nines, 5 nines etc.

\[
1/\lambda_P = 5000 \text{ hours, } 1/\lambda_I = 2000 \text{ hours.}
\]
\[
1/\mu_P = 2 \text{ hours, } 1/\mu_I = 30 \text{ seconds.}
\]
\[
1/\mu_{PB} = 6 \text{ minutes, } 1/\mu_{SB} = 10 \text{ minutes.}
\]

<table>
<thead>
<tr>
<th>$c$</th>
<th>$k$</th>
<th>$A_{\text{exact}}$</th>
<th>$A_{\text{apprx}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.90</td>
<td>0.90</td>
<td>0.9999326</td>
<td>0.9999330</td>
</tr>
<tr>
<td>0.90</td>
<td>0.94</td>
<td>0.9999416</td>
<td>0.9999420</td>
</tr>
<tr>
<td>0.94</td>
<td>0.90</td>
<td>0.9999364</td>
<td>0.9999368</td>
</tr>
<tr>
<td>0.94</td>
<td>0.94</td>
<td>0.9999454</td>
<td>0.9999458</td>
</tr>
</tbody>
</table>