Availability Evaluation of Digital Library Cloud Services

Julian Araújo
cjma@cin.ufpe.br
Prof. Paulo Maciel
prmm@cin.ufpe.br

MoDCS Group
Centro de Informática U·F·P·E
VIRTUS IMPAVIDA

Introduction

- Digital Library:
  - Is an online library in which the resource collections such as books, magazine articles, research papers, images, sound files, videos etc.
  - The data is stored in local servers and accessed remotely through computer networks.

Motivation

- The digital libraries become essential not only in preserving the cultural but also in knowledge sharing for the society.
- Many schools, universities, colleges, and companies have demonstrated interest to digitize their books and have their own digital libraries and provide services for theirs members.

Motivation

- However, the cost of ownership is quite high, and many organizations do not have the ability to run and maintain the digital libraries by themselves.
- In order to provide uninterrupted services through cloud computing, it is important to evaluate and improve the dependability parameters of the underlying infrastructure.

Digital Library

Fig. 1. Digital Library Overview

Architecture

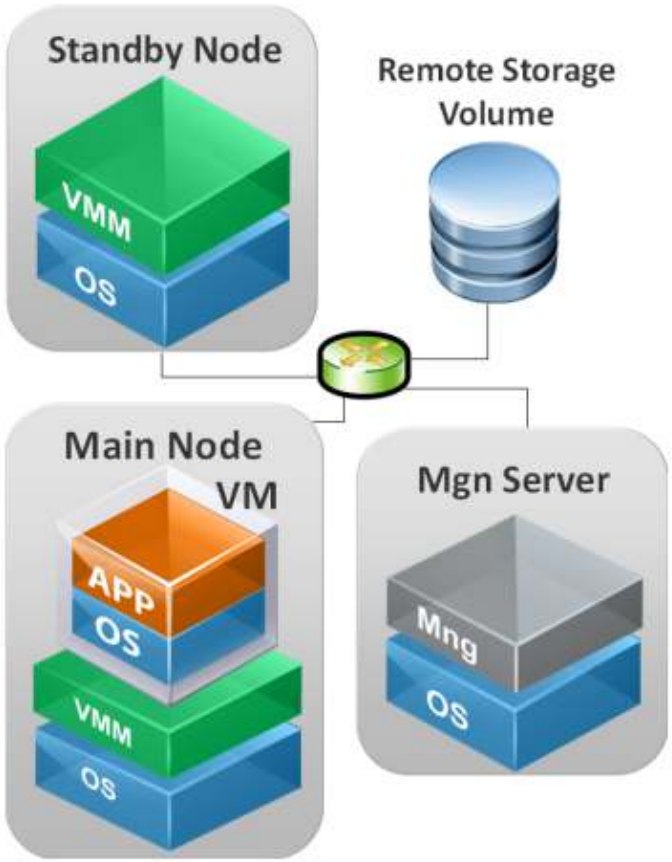


Fig. 2. Architecture Overview.

Models

- Accelerated Life Testing
- Reliability Block Diagram
- Stochastic Petri Nets

Models

- **Accelerated Life Testing** has been used to reduce lifetime of products through the accelearation of performance degradation features.

- Equation 1 represents the ratio of failure rate under stress conditions and acceleration factor.

$$\lambda_o = \lambda_s / A_F$$

- Equation 2 represents the Weibull model of mean time to failure under normal conditions

$$MTTF_o = \theta^{1/\gamma}\Gamma(1 + 1/\gamma)$$

Models

- The **Reliability block diagram** is a combinatorial model initially proposed as a technique for calculating the reliability of a system using intuitive block diagrams.

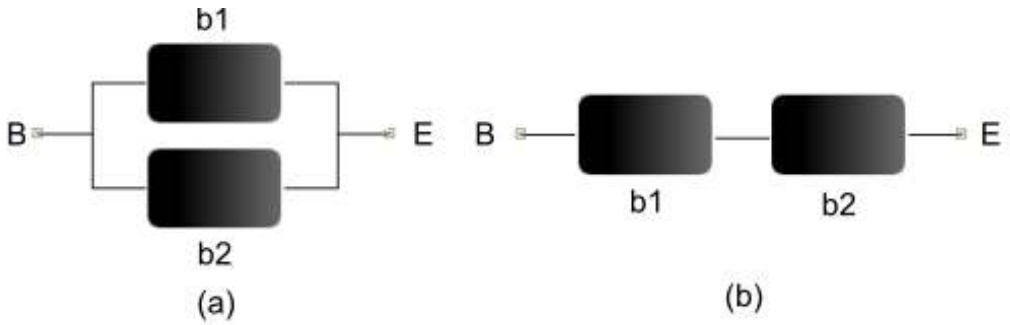


Fig. 3. Reliability block diagram.

Models

- Front-end Model:

Fig. 4. Frontend RBD Model.

- Node Model:

Fig. 5. Node RBD Model.

Models

- Composition Model:

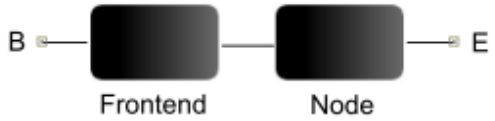


Fig. 6. Frontend and Node RBD Model.

- Front-end and Redundant Node:

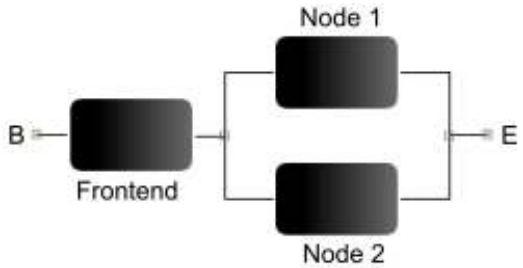


Fig. 7. Frontend + Redundant Node RBD Model.

Models

- SPN Models: **Stochastic Petri Nets** (SPN), which allows the association of probabilistic delays to transitions using the exponential distribution.

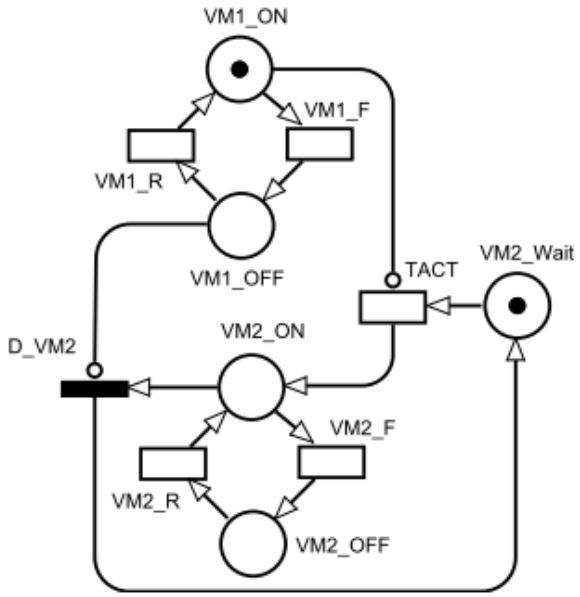


Fig. 8. Cold standby model.

Results

- Results and discussions obtained from the digital library cloud service.
- Scenarios
  - Baseline (no redundancy)
  - Scenario 1 (redundancy in node)
  - Scenario 2 (redundancy in front-end)
  - Scenario 3 (ranging the time to activate the spare redundancy)

Results

- Parameters

TABLE I. RBDs PARAMETERS

Parameters	MTTF	MTTR
Hw	8760 h	100 min
OS	1440 h	1 hr
Management tool	788.4 h	1 hr
VM	2880 h	10 min
Digital Library	6865.3 h	10 min

TABLE II. FACTOR AND LEVEL VALUES

Workload Parameter	Request rate (req/s)	
	Regular	High
Request	0.034	4

TABLE III. MODEL PARAMETERS

Parameters	Values
MTTF	6865.3 hr
MTTR	10 min

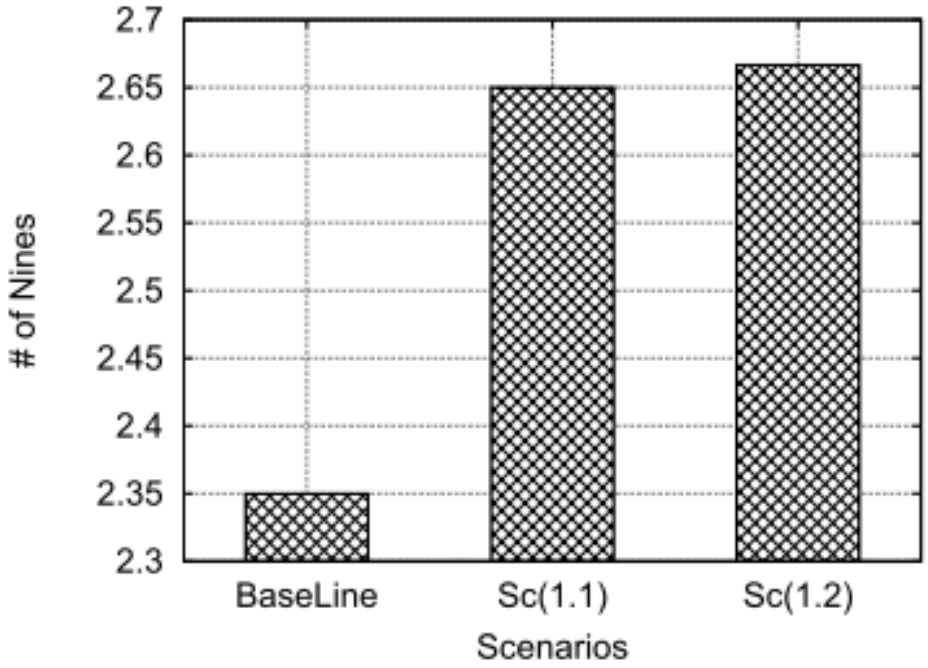
Results

TABLE IV. RBD AVAILABILITY

Model	Availability (%)	Downtime (hr)
Frontend	99.785029	18.83
Node	99.767472	20.36
Frontend + Node	99.553288	39.13

Results

- Scenario 1



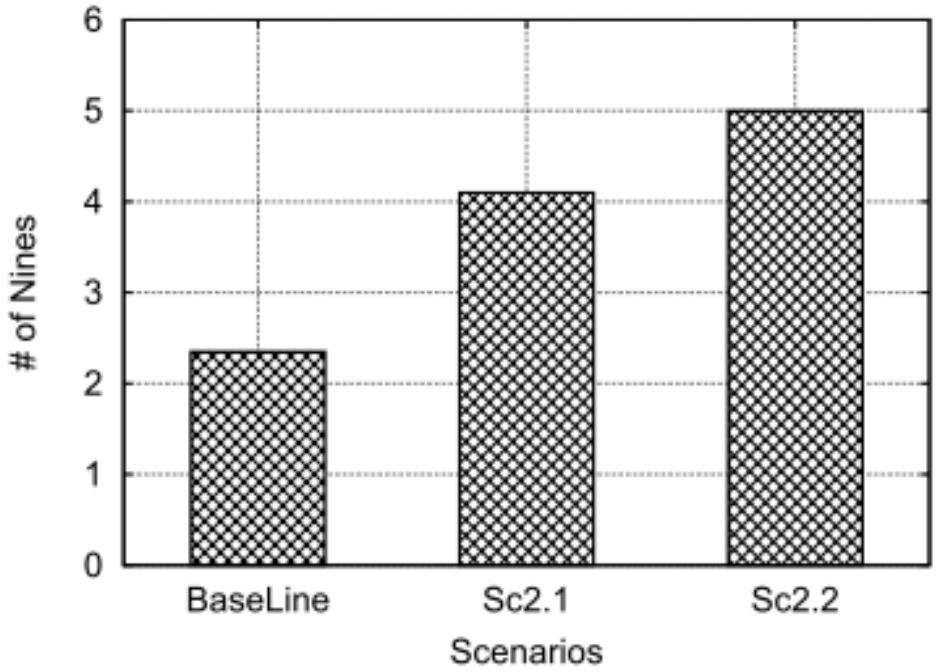
Availability study of Scenario 1.

TABLE V. DOWNTIME VALUES

Configuration	Downtime (min)
Baseline	39.1319
Cold	19.6050
Hot	18.8677

Results

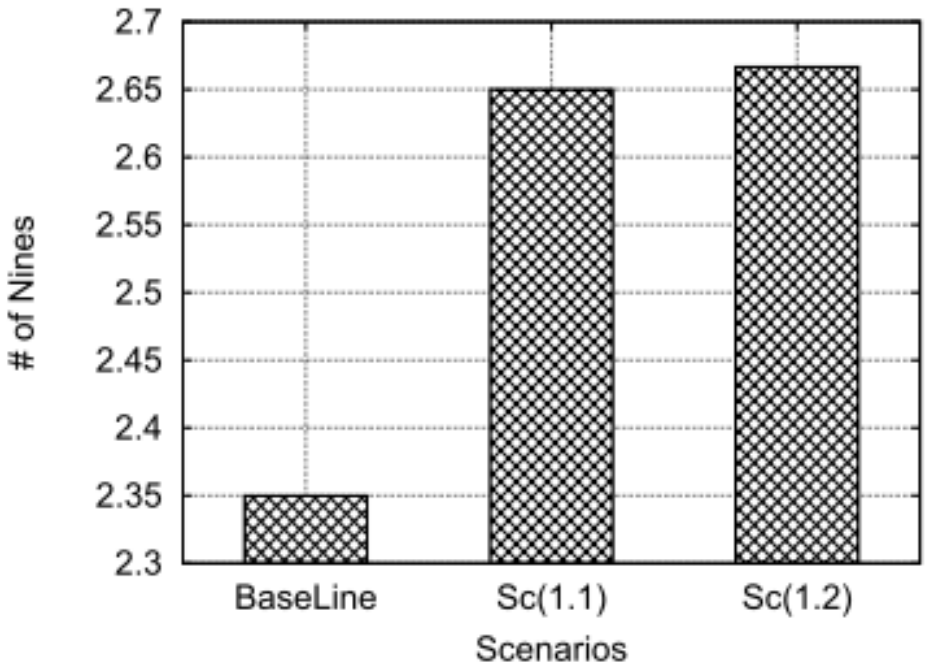
- Scenario 2



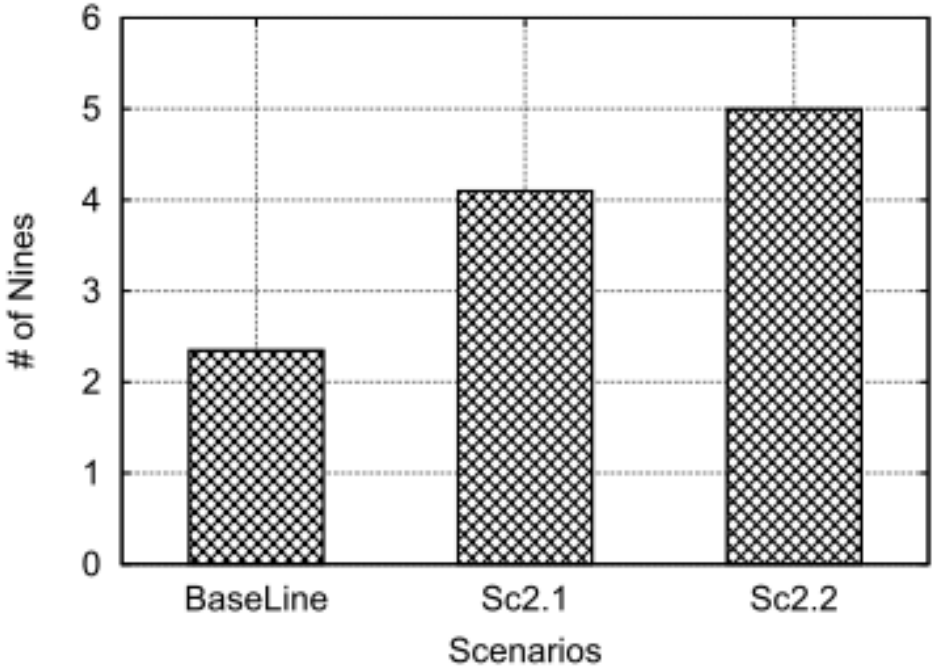
Availability study of Scenario 2.

Results

- Comparing Scenario 1 and 2



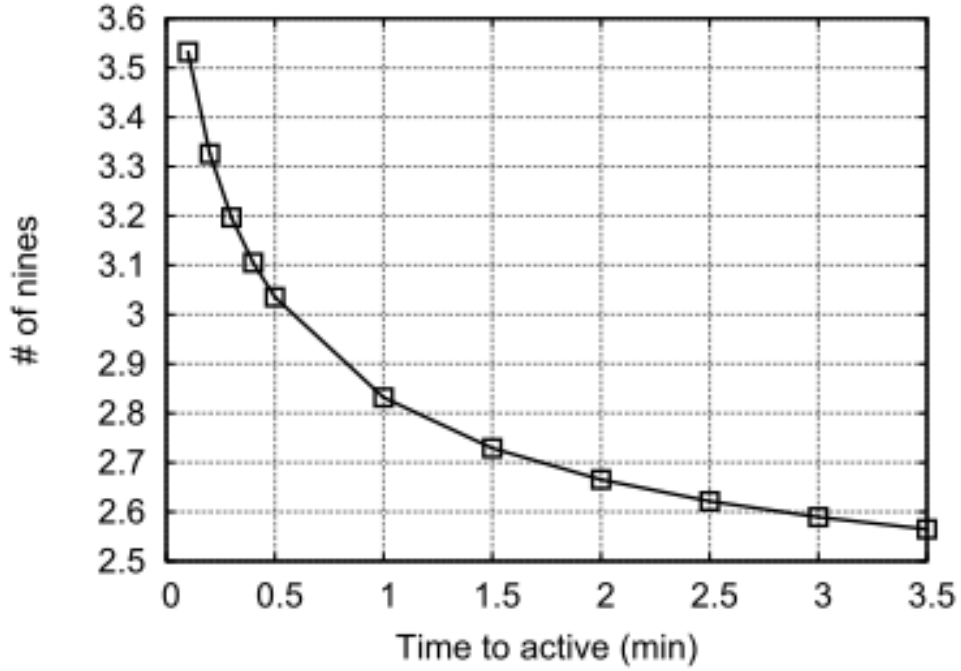
Availability study of Scenario 1.



Availability study of Scenario 2.

Results

- Scenario 3



Availability study of Scenario 3.

Conclusion

- This work presented an hierarchical modeling method to analyze the availability of digital library management.
- The results for the digital library implement in cloud computing employing different redundancy policies show that the conclusions drawn from this paper can improve digital library availability.

Obrigado!