Model-Based Business Continuity Plan for Cloud Infrastructure

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Outline

- Main Propose
- Objectives
- Proposed Approach Overview (Evaluation Process)
- Dependability and Performance Modeling
- Case Study 1
- Case Study 2

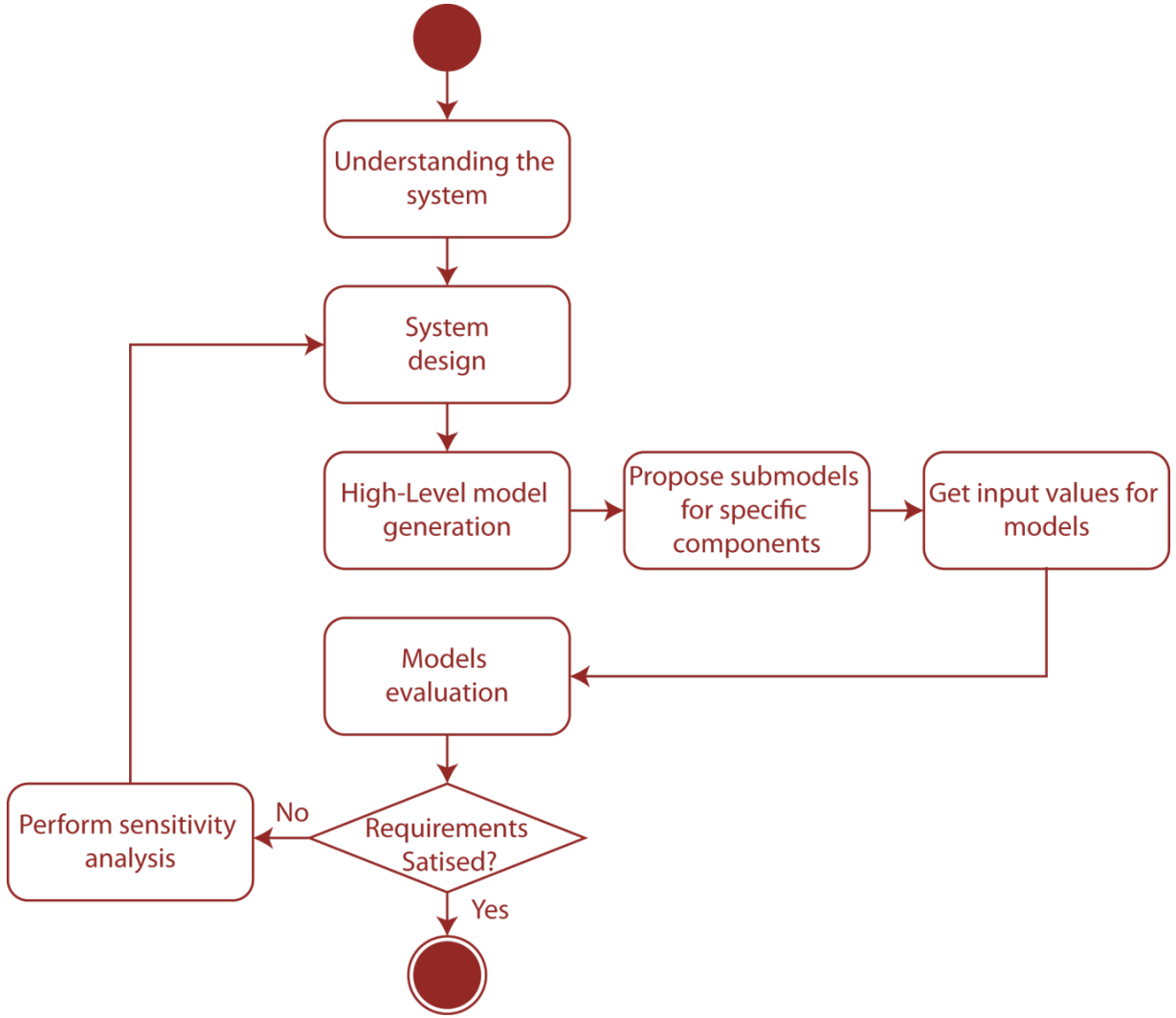
Main Propose

Propose a set of models and modeling process for evaluating geographically distributed cloud computing systems considering possible disaster occurrences

Objectives

- **Adopt redundant backup servers to provide cloud system backup in case of disaster**
- Adopt the evaluation models to estimate the costs related to data center allocation
- Evaluation considering different priorities for data center user utilization

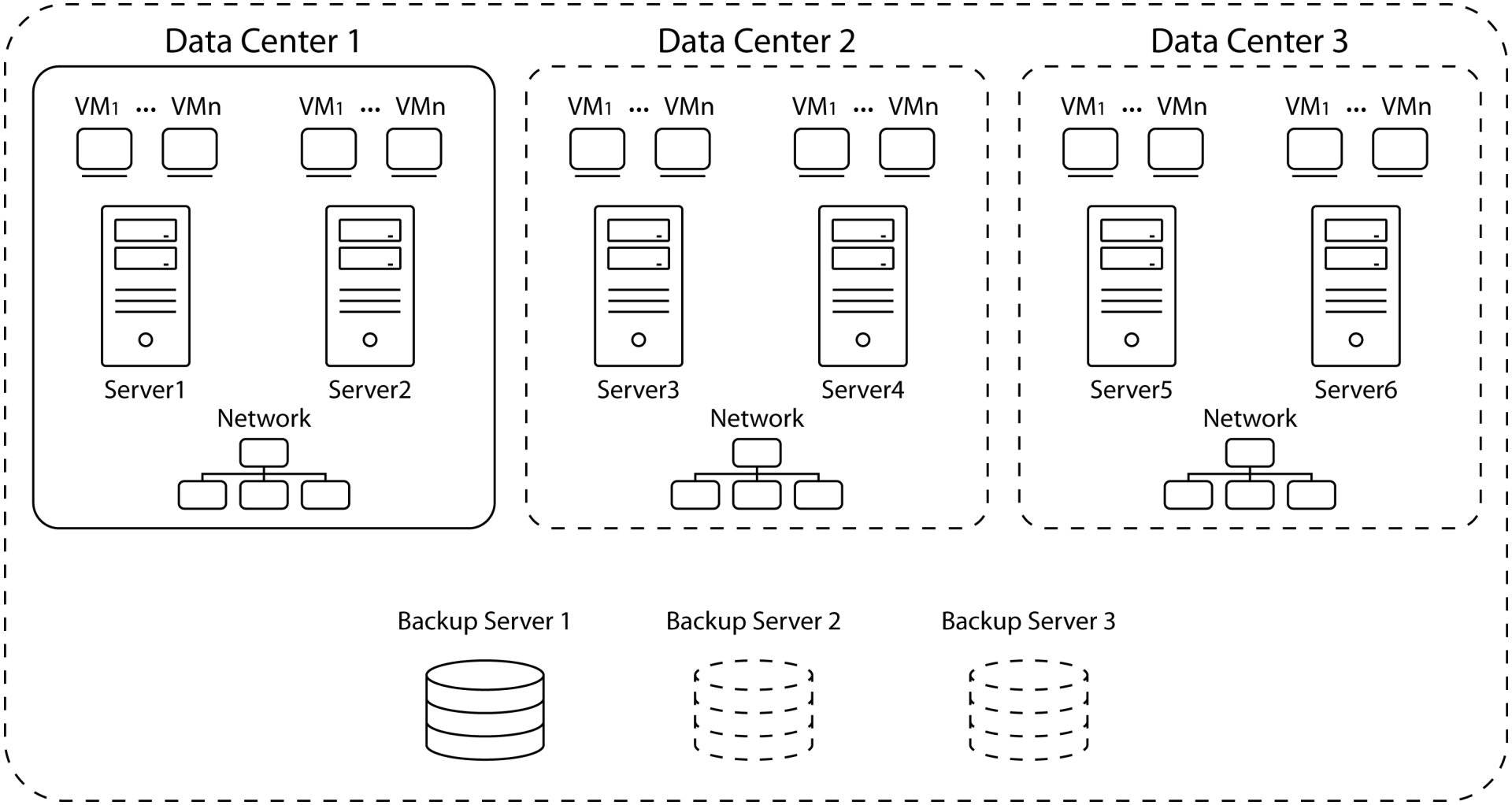
Proposed Approach Overview (Evaluation Process)



Proposed Approach Overview (understanding the system)

- **Minimum acceptable availability**
- **Minimum acceptable response time**
- Minimum acceptable Capacity Oriented Availability (COA)
- Minimum acceptable system utilization
- Minimum acceptable requesting jobs
- Minimum acceptable system recovery after a disaster

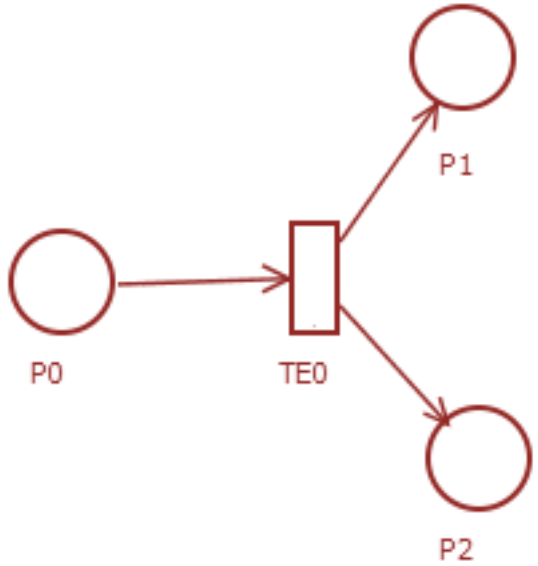
Proposed Approach Overview (system design)



Dependability and Performance Modeling

- Reliability Block Diagram (RBD)

- Stochastic Petri Net (SPN)



Case Study 1

Case Study 1

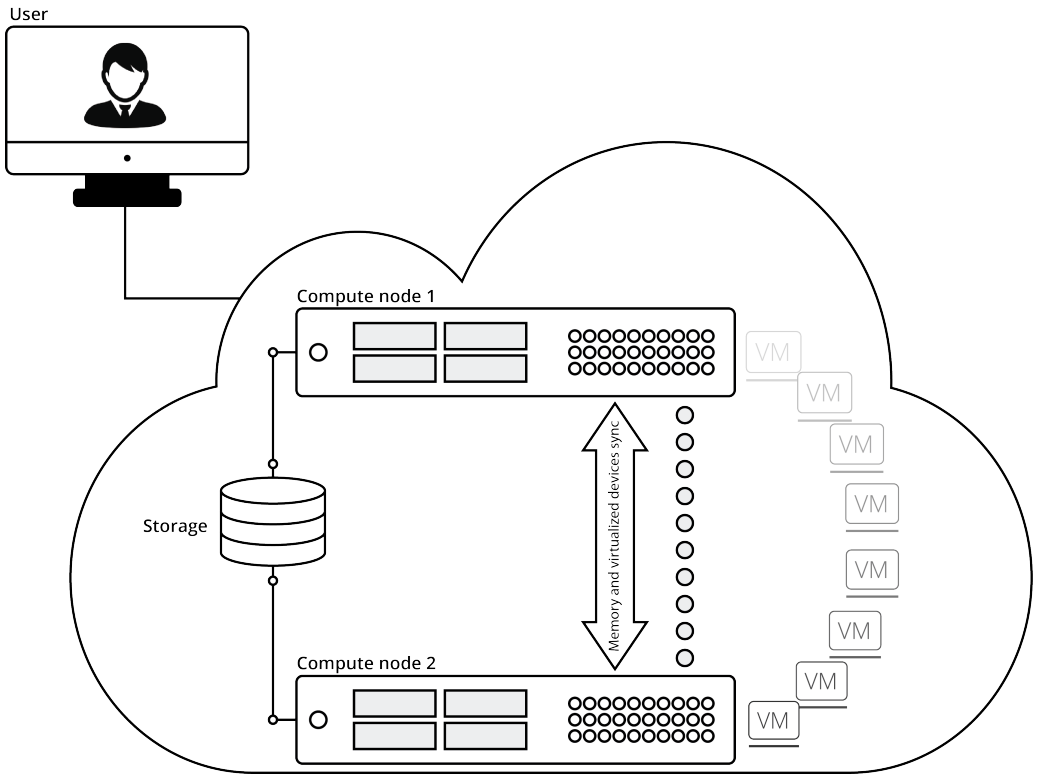


Figure 1: Live migration

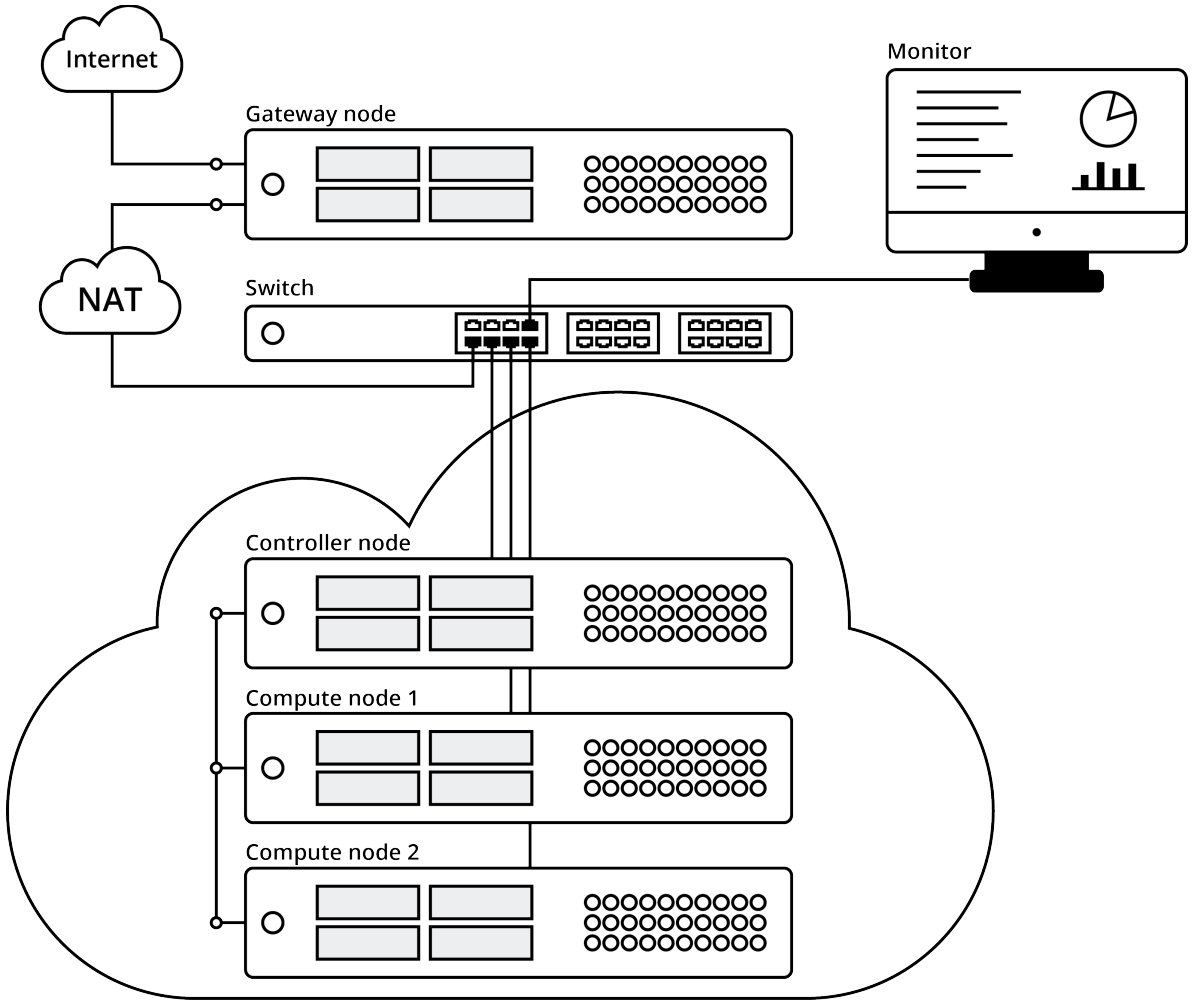


Figure 2: Experiment layout

Case Study 1

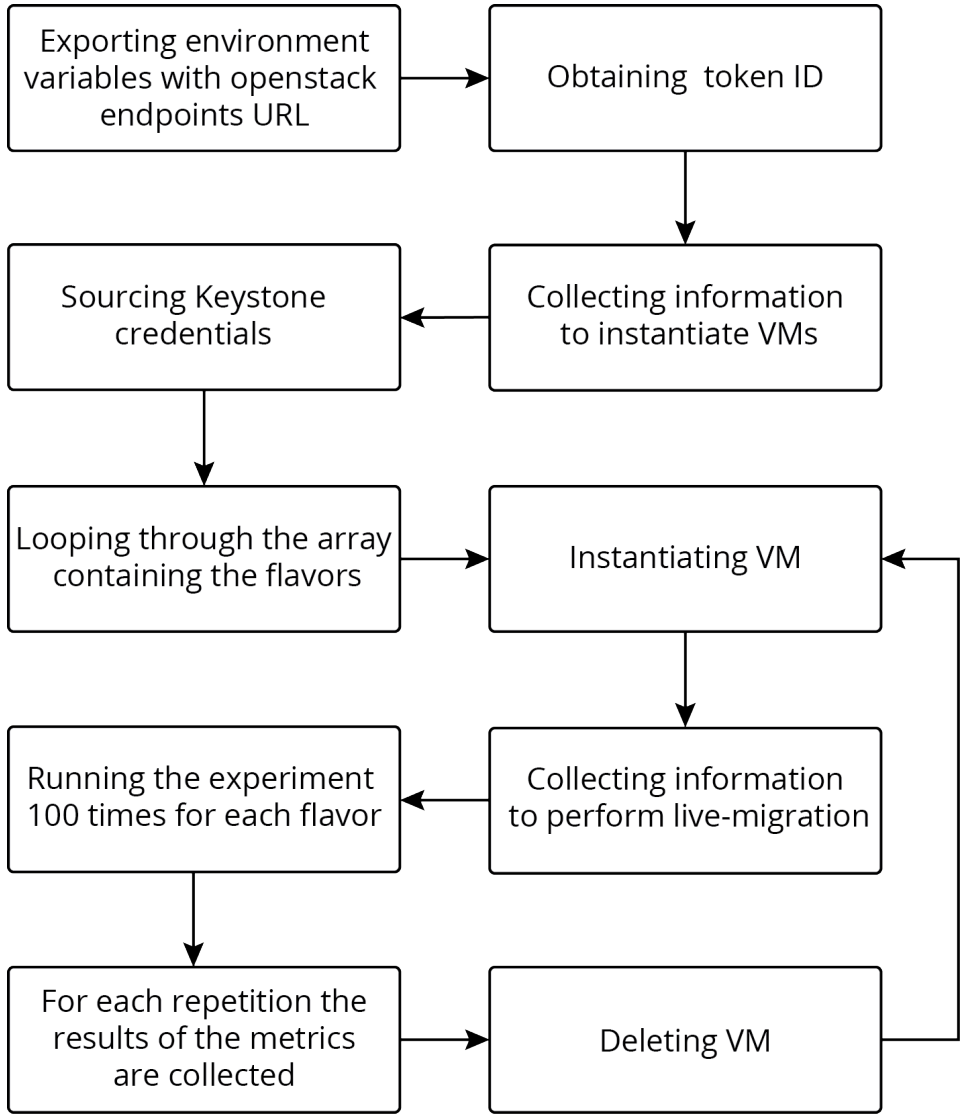


Figure 3: Flow chart of the script for live-migration result capturing

Case Study 2

Scenarios

Scenarios	VCPUs	Disk Root (GB)	RAM (MB)
tiny	1	5	512
small	1	10	2048
medium	2	15	4096
large	4	20	8192
xlarge	8	25	16384

Results (Live migration uptime and downtime percentage)

	Metric	tiny	small	medium	large	xlarge
Shared	uptime	74%	73%	76%	78%	81%
	downtime	26%	26%	24%	22%	19%
Block	uptime	77%	77%	80%	81%	84%
	downtime	23%	23%	20%	19%	16%
Volume	uptime	58%	59%	63%	64%	69%
	downtime	42%	41%	37%	36%	31%

Case Study 1

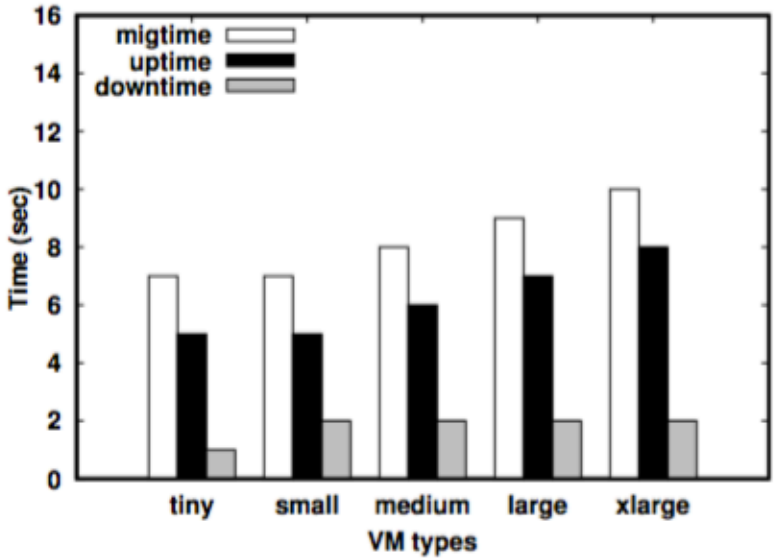
Table 1: Virtual hardware templates (Flavors)

Flavor	VCPUs	Root disk (GB)	RAM (MB)
tiny	1	5	512
small	1	10	2048
medium	2	15	4096
large	4	20	8192
xlarge	8	25	16384

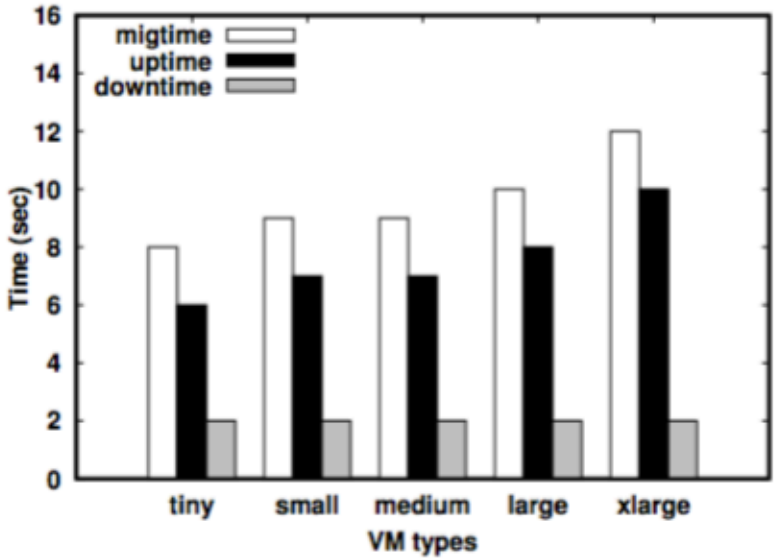
Table 2: Live migration uptime and downtime percentage

	Metric	tiny	small	medium	large	xlarge
Shared	uptime	74%	73%	76%	78%	81%
	downtime	26%	26%	24%	22%	19%
Block	uptime	77%	77%	80%	81%	84%
	downtime	23%	23%	20%	19%	16%
Volume	uptime	58%	59%	63%	64%	69%
	downtime	42%	41%	37%	36%	31%

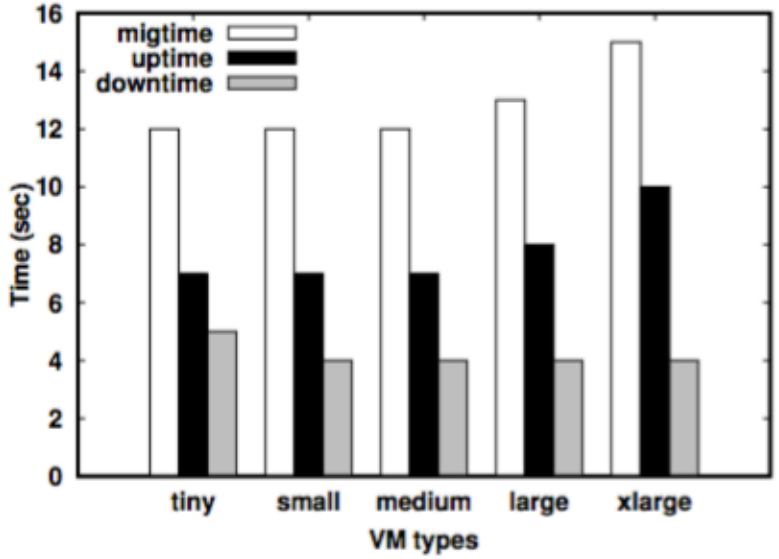
Case Study 1



(a) Shared



(b) Block



(c) Volume

Figure 4: Comparison of resources

Case Study 1

DOE analysis (full factorial) $$n = 1 + \sum_{i=1}^{k} (n_i - 1)$$

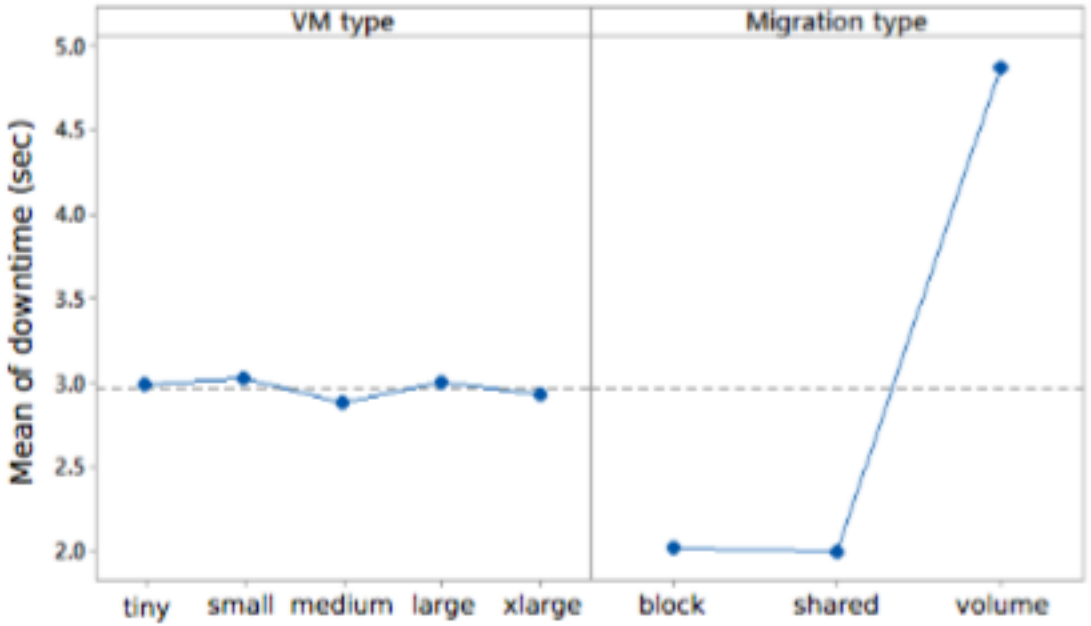


Figure 5: Main e ects plot for migration downtime

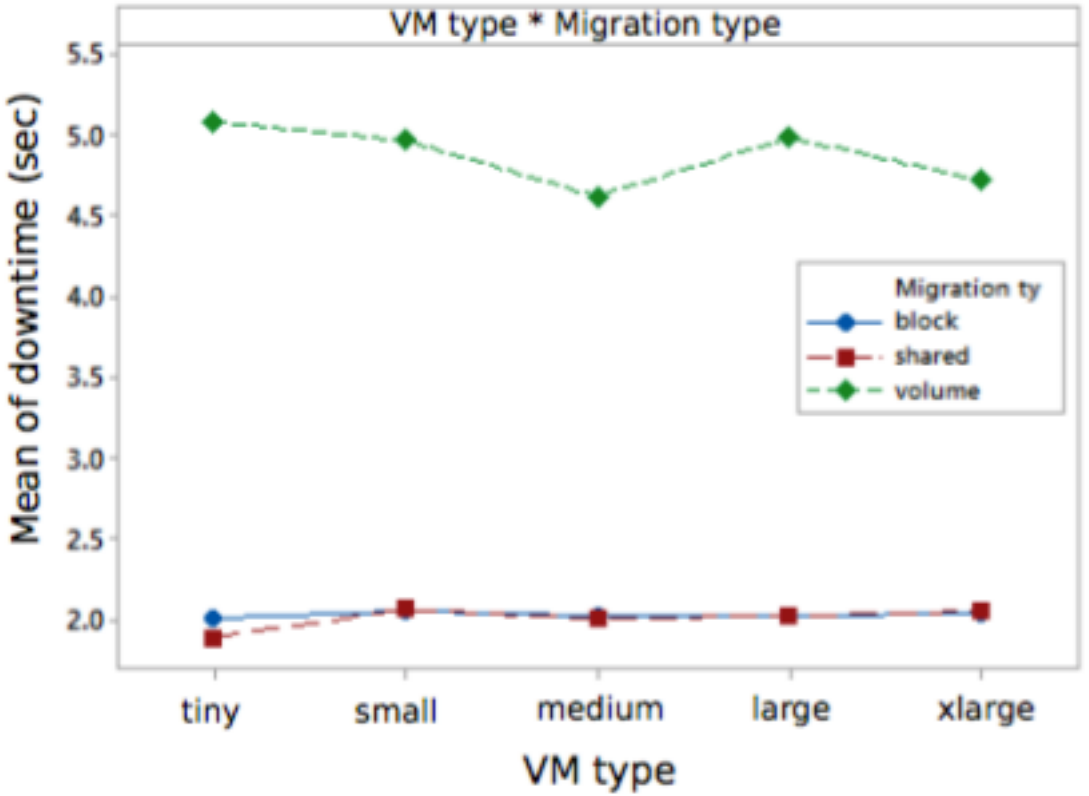


Figure 6: Interaction plot for downtime

Case Study 1

The 33rd ACM/SIGAPP Symposium On Applied Computing
SAC 2018

Performance Evaluation of Live Migration Mechanism in Cloud for Business Continuity Plan

Case Study 2

Case Study 2

Scenarios

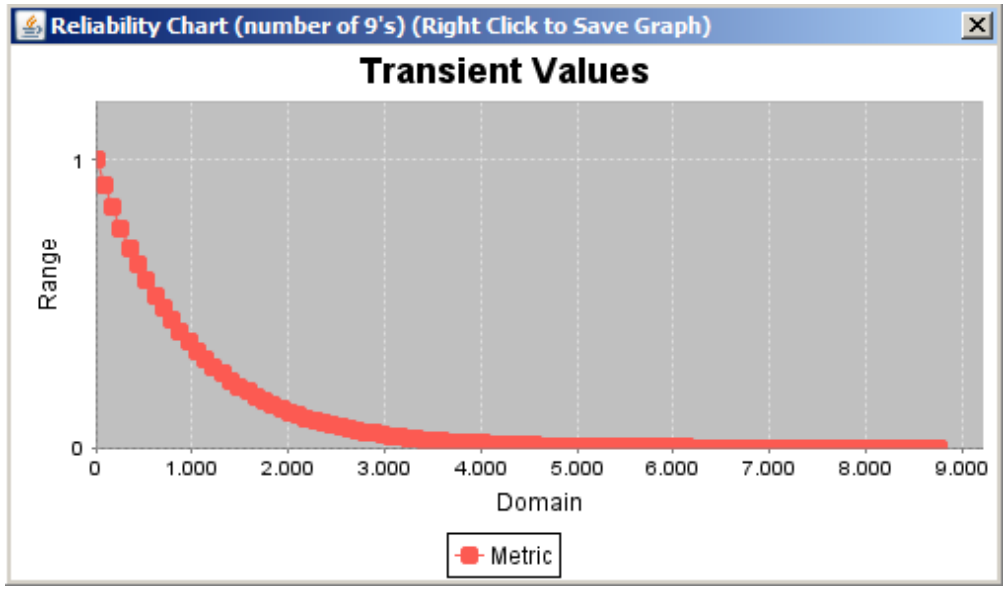
Scenarios	Number of Data Centers	Number of Servers	Location
S1	1	1	Recife
S2	2	2	Recife
S3	3	3	Recife

Parameters

Component	MTTF(h)	MTTR(h)
Server Operating System	4000	1
Server Hardware	1000	12
Switch	43000	4
Router	14077	4
NAS	20000	2
VM	2880	0.5
Backup Server	50000	0.5

Case Study 2

Reliability chart

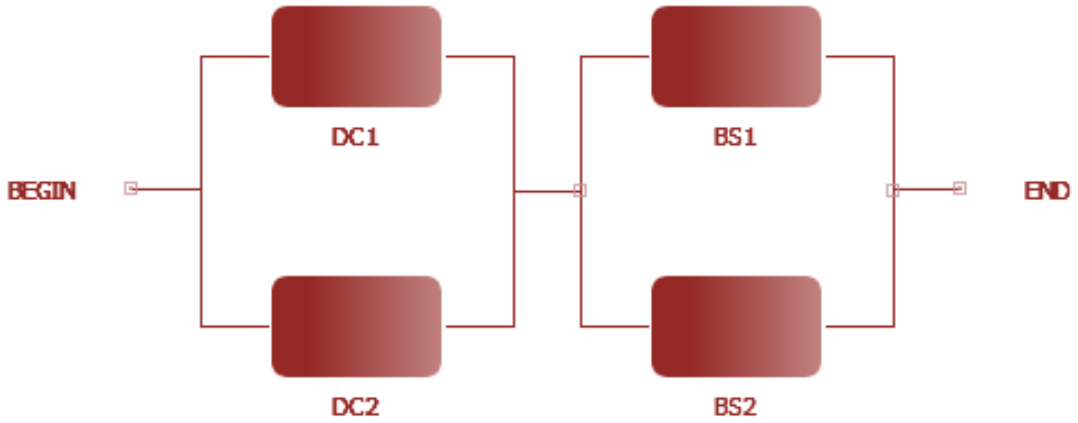


Availability: 0.9994825050428826
Number of 9's: 3.2860938779614624
Annual Downtime: 4.536263903510243 hours

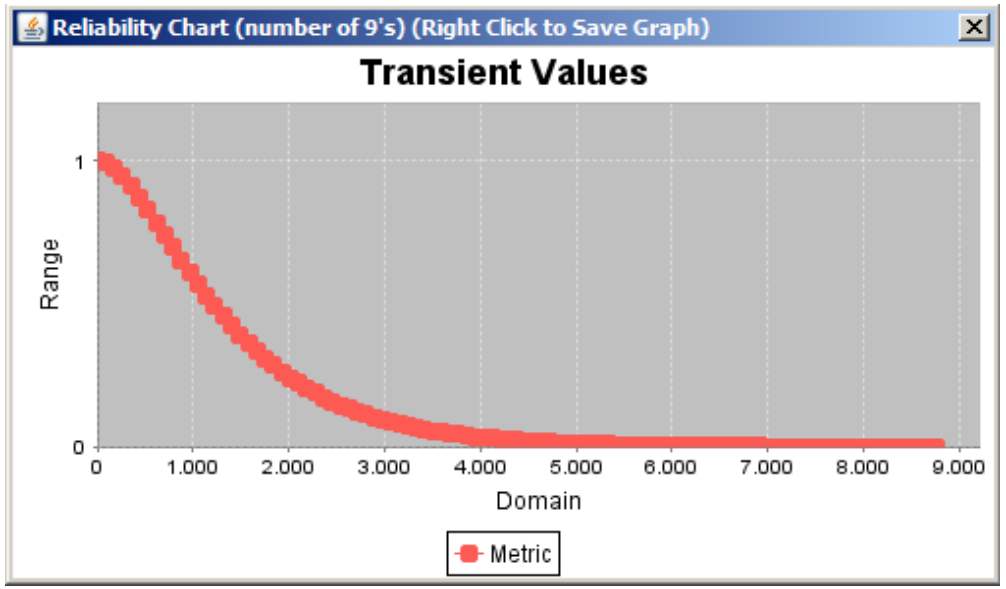
Structural function (availability)

$A=(A_{DC1})*(A_{BS1})$

Case Study 2



Reliability chart

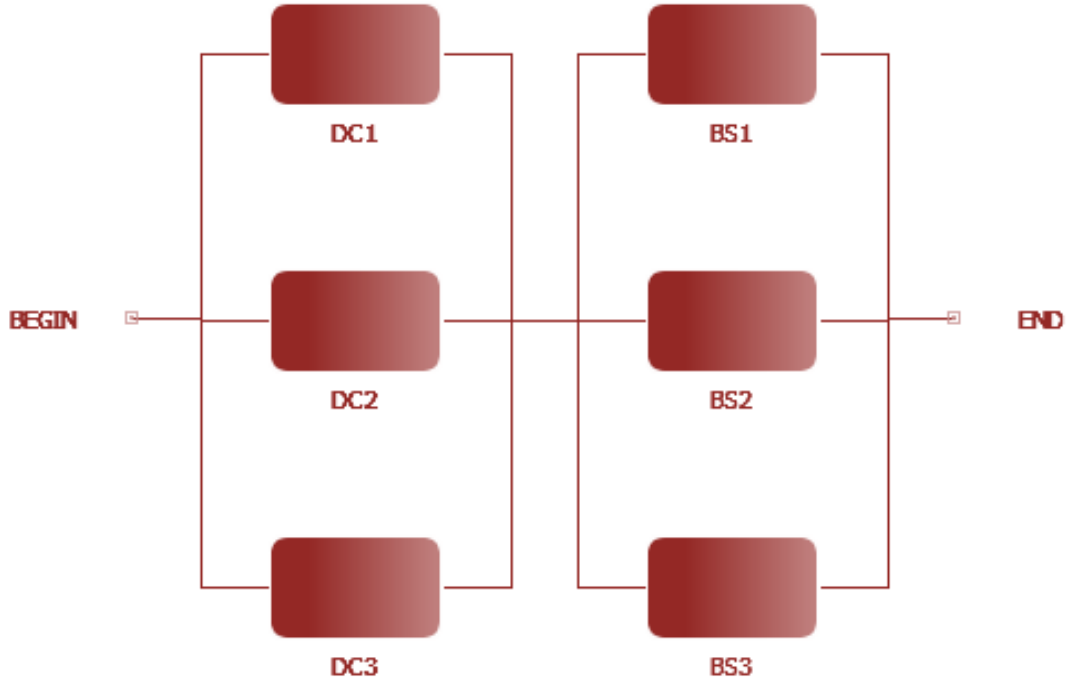


Availability: 0.9999997232997963
Number of 9's: 6.557990521098848
Annual Downtime: 0.0024255021794897702 hours

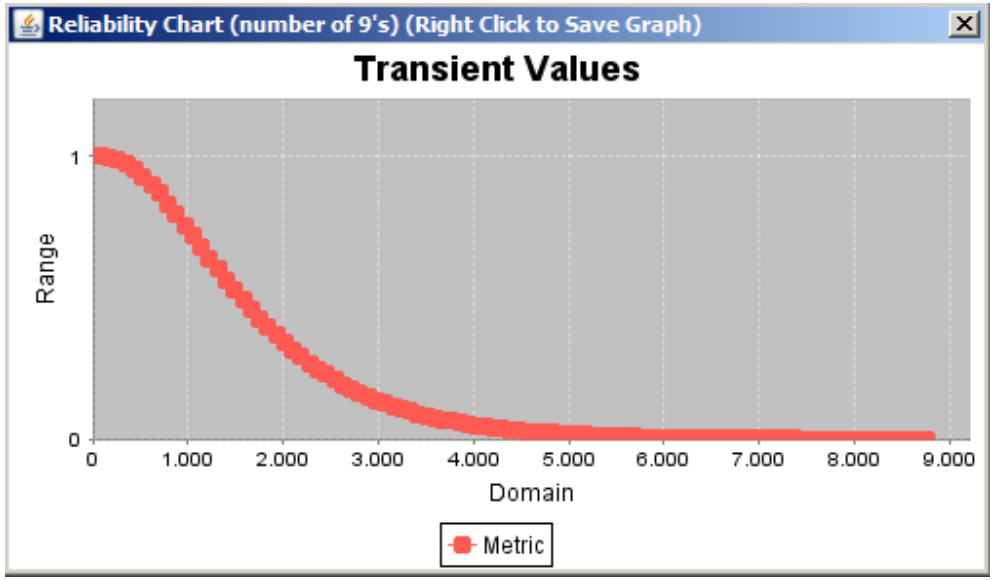
Structural function (availability)

$A=(1-(1-A_{DC1}) * (1-A_{DC2}))*(1-(1-A_{BS1}) * (1-A_{BS2}))$

Case Study 2



Reliability chart

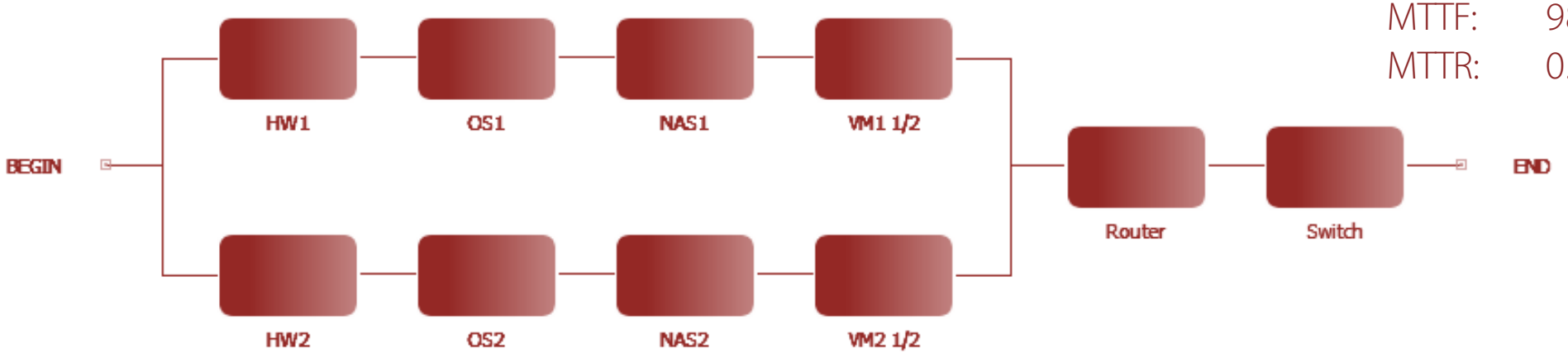


Availability: 0.9999999998545273
Number of 9's: 9.837218551887254
Annual Downtime: 1.275186845468183 6E-6 hours

Structural function (availability)

$A=(1-(1-A_{DC1}) * (1-A_{DC2}) * (1-A_{DC3}))*(1-(1-A_{BS1}) * (1-A_{BS2}) * (1-A_{BS3}))$

Case Study 2



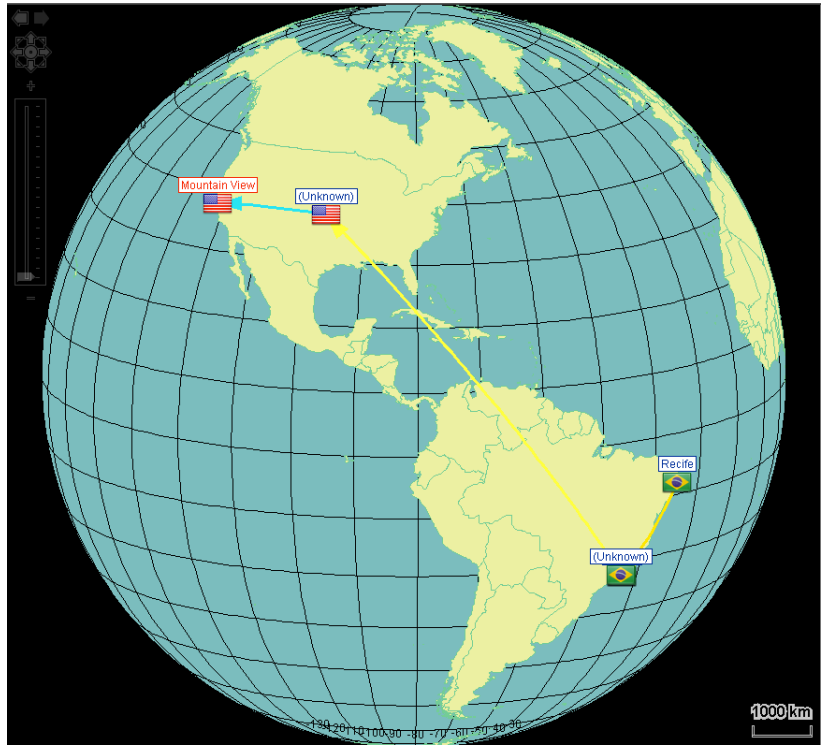
MTTF: 984.7214184925383
MTTR: 0.5181650317065526

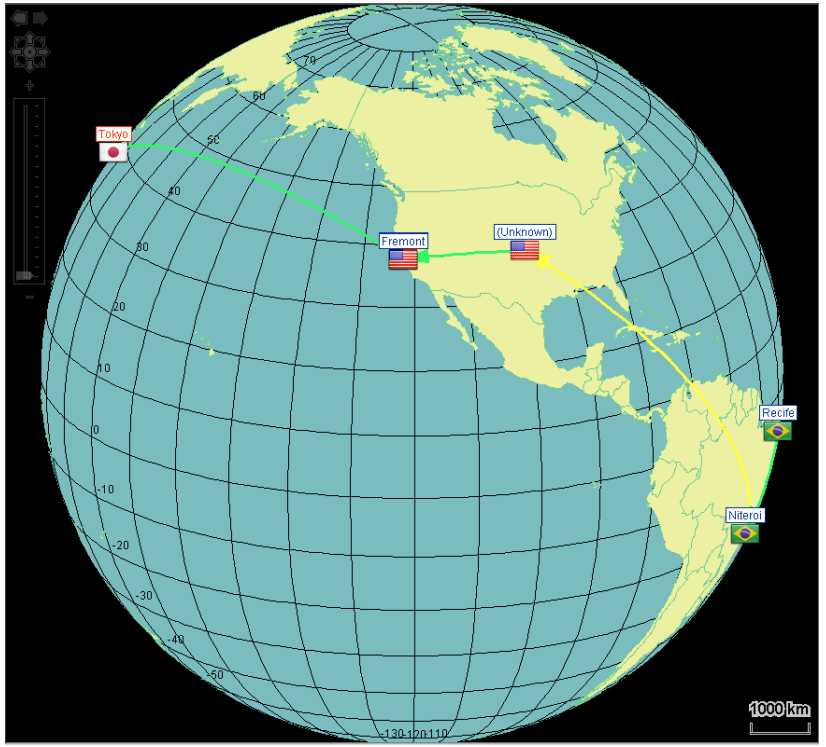
MTTF: 50000
MTTR: 0.5

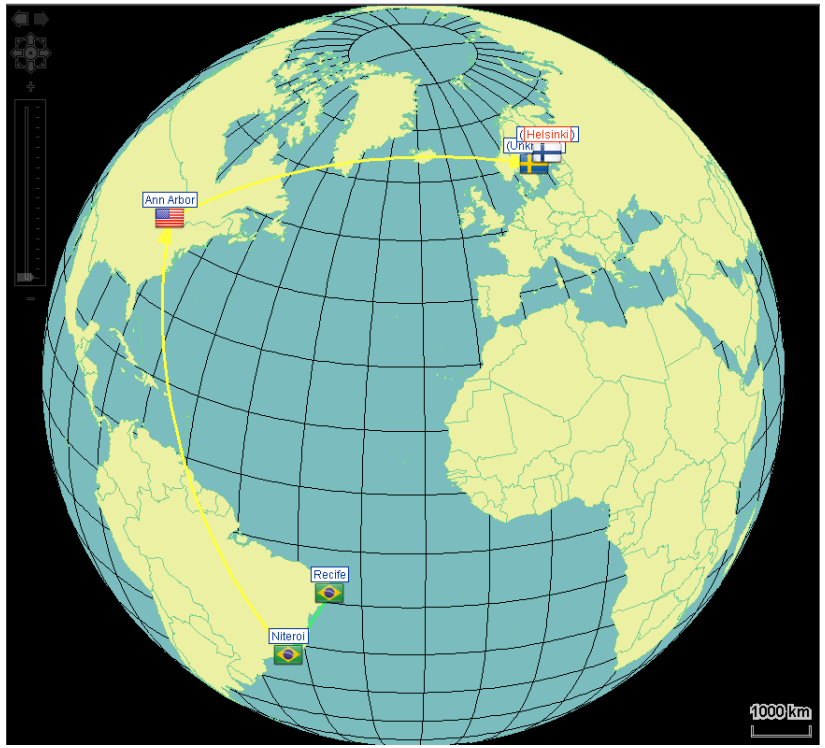
Case Study 2

Distance between servers

Location 1	Location 2	Distance (Km)
Recife	Mountain View	14,897
Recife	Helsinki	17,305
Recife	Tokio	21,165





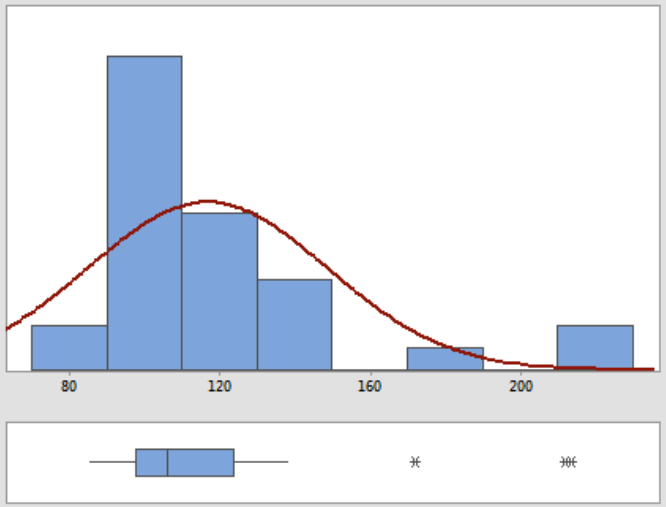


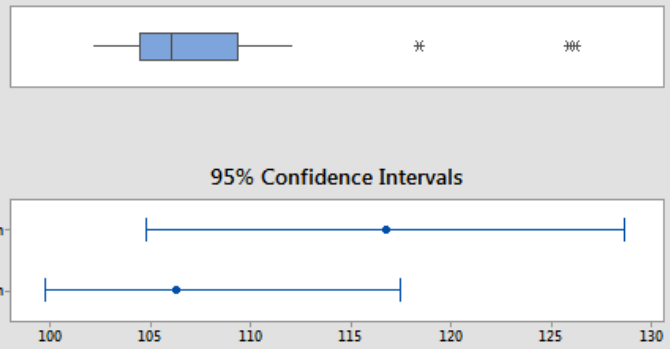
Fonte: Open Visual Trace Route Software

Summary Statistics Report (Case Study 2)

Response time evaluation

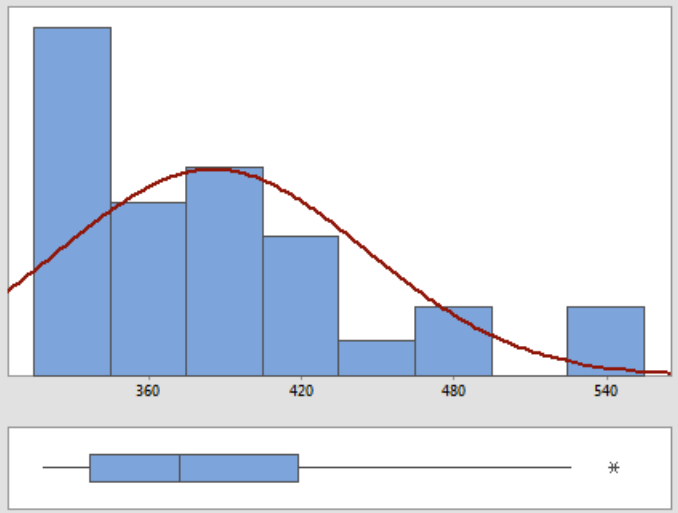
google.com

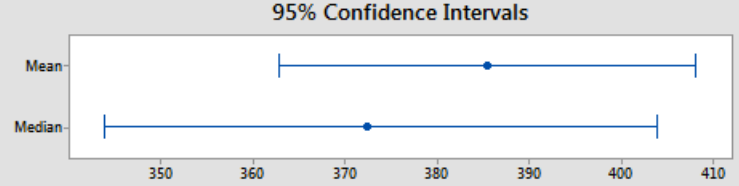




Anderson-Darling Normality Test	
A-Squared	2,44
P-Value	<0,005
Mean	116,79
StDev	31,97
Variance	1022,11
Skewness	2,04940
Kurtosis	4,12722
N	30
Minimum	85,57
1st Quartile	97,56
Median	106,34
3rd Quartile	123,98
Maximum	213,57
95% Confidence Interval for Mean	
104,85	128,73
95% Confidence Interval for Median	
99,78	117,48
95% Confidence Interval for StDev	
25,46	42,98

helsinki.fi

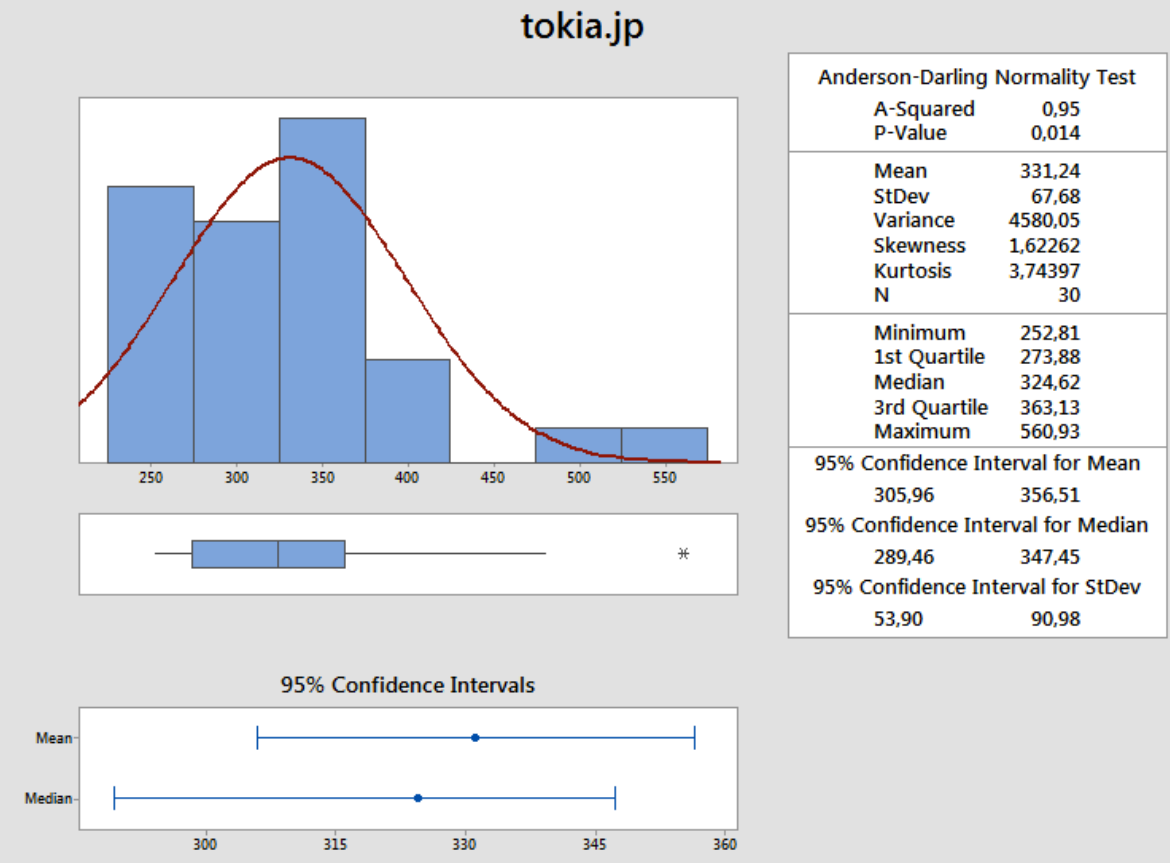




Anderson-Darling Normality Test	
A-Squared	1,00
P-Value	0,011
Mean	385,49
StDev	60,66
Variance	3679,57
Skewness	1,10027
Kurtosis	0,73372
N	30
Minimum	318,93
1st Quartile	337,06
Median	372,52
3rd Quartile	419,08
Maximum	543,23
95% Confidence Interval for Mean	
362,84	408,14
95% Confidence Interval for Median	
343,97	404,04
95% Confidence Interval for StDev	
48,31	81,55

Summary Statistics Report (Case Study 2)

Response time evaluation



Anderson-Darling Normality Test	
A-Squared	0,95
P-Value	0,014
Mean	331,24
StDev	67,68
Variance	4580,05
Skewness	1,62262
Kurtosis	3,74397
N	30
Minimum	252,81
1st Quartile	273,88
Median	324,62
3rd Quartile	363,13
Maximum	560,93
95% Confidence Interval for Mean	
305,96	356,51
95% Confidence Interval for Median	
289,46	347,45
95% Confidence Interval for StDev	
53,90	90,98

Thank you

Workshop MoDCS Nov'17