



## **QoS-Aware Backup Model for Cloud SDN Using Feedforward Neural Networks**

Dissertation

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**M. Sc. Ammar Alsous**

Supervisors: Prof. Dr.-Ing. habil. Jorge Marx Gómez

Prof. Dr. Manuel Mora

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## **Abstract**

Avoiding data loss is an important operation in data centers. This target could be achieved by several options. One of the common and efficient methods for that is data backup. However, using a private connection to guarantee the Quality of Service (QoS) is a costly operation. Backup services could be offered by cloud providers to reduce the costs by increasing the infrastructure utilization level (multiple users). In addition, QoS level could be guaranteed in cloud providers using different strategies. Software Defined Networking (SDN) is a new networking paradigm. Large IT companies and cloud providers have started to use SDN in their internal networks. SDN depends on the concept of separating data and control planes in classical networks. Using SDN, computer networks could be virtualized and administrated in a simpler and more efficient manner.

This research proposes a solution for the problem of guaranteeing the QoS for data centers backup operations over cloud networks using SDN. Data centers need this service as an alternative for costly private network connections. This research introduces an efficient-cost backup model for cloud providers using SDN and AI techniques. It can assure the QoS by choosing the right path (if available) according to the payment, the customer's requirements and the status of the provider's network.

## Table of Contents

Abstract .....	2
Table of Contents .....	3
List of Abbreviations and Acronyms .....	7
List of Figures .....	9
List of Tables.....	11
1 Introduction.....	13
1.1 Problem Definition.....	14
1.2 Research Goals and Questions .....	15
1.2.1 Research Goals.....	15
1.2.2 Research Questions .....	15
1.3 Main Contribution .....	15
1.4 Thesis Structure.....	16
2 Literature Review and Related Work.....	17
2.1 Theoretical Background on Cloud Computing Services .....	17
2.1.1 Network as a Service (NaaS) .....	20
2.2 Network Quality of Service (QoS).....	21
2.2.1 QoS Criteria .....	21
2.2.2 QoS in Cloud Network Services (NaaS).....	23
2.3 Software Defined Networking (SDN).....	24
2.3.1 SDN Principles.....	24
2.3.2 SDN Architecture.....	25
2.3.3 OpenFlow.....	27
2.3.4 SDN in Cloud Networks (Inter-Site).....	28
2.3.5 Green Energy and SDN.....	29
2.3.5.1 ICT Power Consumption in Data Centers.....	29
2.3.5.2 SDN and Energy Efficiency in Data Centers .....	31
2.3.5.3 Trade-Off between QoS and Energy Efficiency .....	32
2.3.5.4 Sustainability in Green Networking and SDN .....	32
2.4 QoS and Software Defined Networking.....	33
2.4.1 QoS before Software Defined Networking.....	33
2.4.2 QoS Improvements Using Software Defined Networking.....	35
2.4.2.1 Resource Reservation.....	35
2.4.2.2 Per-flow Routing.....	36

2.4.2.3	Queue Management and Packet Scheduling .....	37
2.4.2.4	Policy Enforcement .....	37
2.4.3	QoS Approaches Using SDN in Normal Networks .....	39
2.4.4	QoS Approaches Using SDN in Cloud Environment .....	43
2.5	Neural Networks.....	48
2.5.1	Types of Neural Networks .....	49
2.5.2	Learning Methods .....	51
2.5.3	Advantages and Disadvantages.....	52
2.5.4	Deep Neural Networks.....	53
2.6	Fuzzy Logic .....	54
2.7	Suitable AI Technique for this Research.....	55
2.8	Related Work and Research Scope.....	56
3	Research Methodology .....	61
3.1	Design Science in Information Systems.....	61
3.2	Design Science Research Methodology (DSRM) Process Model.....	63
4	Proposed Model and System Design.....	65
4.1	Satisfy QoS Requirements.....	65
4.2	Model Design .....	68
4.3	Network Topology 1 .....	70
4.4	Network Topology 2 .....	72
4.5	Steps and Phases.....	76
4.6	Activity Diagram .....	78
4.7	Sequence Diagram.....	81
4.8	Use Case .....	86
4.8.1	Classical Networks.....	86
4.8.1.1	Use Case Diagram for Classical Networks .....	86
4.8.1.2	Use Case (Classical Networks) Example .....	87
4.8.2	The Proposed Approach (SDN) .....	90
4.8.2.1	Use Case Diagram for the Proposed Approach (SDN).....	91
4.8.2.2	Use Case (the Proposed Approach) Example.....	91
4.8.3	Comparison .....	95

5	Model Implementation and Evaluation .....	97
5.1	Development Environment.....	97
5.2	Automation Process.....	98
5.3	Evaluation Strategy .....	98
5.4	Evaluation and Results Analysis .....	100
5.4.1	Initial Results Analysis .....	100
5.4.2	Evaluation AI Techniques.....	103
5.4.3	Evaluation Datasets.....	104
5.4.4	Evaluation Matrix .....	104
5.4.5	Evaluation Results.....	106
5.4.5.1	Small Network - Small Data .....	108
5.4.5.2	Big Network - Small Data.....	110
5.4.5.3	Small Network - Medium Data .....	112
5.4.5.4	Big Network - Medium Data.....	114
5.4.5.5	Small Network - Big Data.....	116
5.4.5.6	Big Network - Big Data .....	118
5.4.6	Results Analysis and Comparisons.....	120
5.4.7	The Final Evaluation Matrix.....	122
5.5	Expert Interviews .....	123
5.5.1	First Company: CEWE .....	124
5.5.1.1	General Feedback.....	124
5.5.1.2	Questions and Answers.....	125
5.5.2	Second Company: Brille24 .....	126
5.5.2.1	General Feedback.....	126
5.5.2.2	Questions and Answers.....	127
6	Conclusion and Future work .....	129
6.1	Summary of the Research.....	129
6.2	Future Work .....	133
7	Appendix.....	135
7.1	Mininet .....	135
7.1.1	Mininet Features .....	136
7.1.2	Mininet Technical Concept.....	137
7.1.3	Mininet Performance.....	137
7.1.3.1	Mininet in Comparison to Full System Virtualization Solutions .....	138
7.1.3.2	Mininet in Comparison to Hardware Testbeds.....	138

7.1.3.3 Mininet in Comparison to Other Emulators/Simulators.....	138
7.1.4 Mininet Limitations.....	138
7.1.5 Using APIs in Mininet .....	139
7.1.5.1 Low Level .....	139
7.1.5.2 Medium Level .....	140
7.1.5.3 High Level.....	140
7.1.6 Mininet Example.....	141
8 References.....	142

## List of Abbreviations and Acronyms

AI	Artificial Intelligence
ANN	Artificial Neural Network
API	Application Programming Interface
AS	Autonomous System
AWS	Amazon Web Services
CAGR	Compound Annual Growth Rate
CDN	Content Delivery Network
CDPI	Control to Data-plane Interface
CLI	Command-Line Interface
CNN	Convolutional Neural Network
CPI	Control Plane Interface
DB	Database
DC	Data Center
DiffServ	Differentiated Services
DL	Deep Learning
DNN	Deep Neural Network
DSCP	Differentiated Services Code Point
DSRM	Design Science Research Methodology
FIFO	First-In-First-Out
HFSC	Hierarchical Fair Service Curve
HTB	Hierarchical Token Bucket
IaaS	Infrastructure as a Service
ICT	Information and Communications Technology
IntServ	Integrated Services
IP	Internet Protocol
IPsec	IP security
IS	Information System
IT	Information Technology
LER	Label Edge Router
LPF	Longest Path First
LSP	Label Switched Path
LSR	Label Switching Router
ML	Machine Learning
MPLS	Multiprotocol Label Switching
Mt	Million Metric Tons



NaaS	Network as a Service
NBI	Northbound Interface
NCL	Network Control Layer
NE	Network Element
NN	Neural Network
OSPF	Open Shortest Path First
OVSDB	Open vSwitch Database Management Protocol
PaaS	Platform as a Service
PLR	Packet Loss Ratio
PoC	Proof of Concept
PUE	Power Usage Effectiveness
QoS	Quality of Service
RED	Random Early Detection
RMSE	Root Mean Square Error
RNN	Recurrent Neural Network
RSVP	Resource Reservation Protocol
RTT	Round Trip Time
SaaS	Software as a Service
SDN	Software Defined Networking
SFQ	Stochastic Fairness Queueing
SLA	Service-Level Agreement
SNMP	Simple Network Management Protocol
SOA	Service-Oriented Architecture
TCAM	Ternary Content-Addressable Memory
ToS	Type of Service
vNetwork	Virtual Network
VPN	Virtual Private Network

## List of Figures

Figure 1. Problem Definition .....	14
Figure 2. Cloud Structure .....	19
Figure 3. Network Quality of Service (QoS) .....	23
Figure 4. SDN Architecture 1 .....	25
Figure 5. SDN Architecture 2 - Simpler.....	26
Figure 6. Traditional Network Architecture vs SDN Architecture .....	27
Figure 7. ICT Worldwide Power Consumption Rate .....	30
Figure 8. ICT CO2 Emissions.....	30
Figure 9. New Floodlight Architecture with QoS Module.....	40
Figure 10. SDN with QoS Support.....	41
Figure 11. Approach Testing Using Proof of Concept.....	46
Figure 12. Network Control Layer (NCL) .....	47
Figure 13. Feedforward (Single-Layer) Neural Networks .....	49
Figure 14. Feedforward (Multi-Layer) Neural Networks .....	50
Figure 15. Recurrent Neural Networks .....	50
Figure 16. Research Scope .....	59
Figure 17. Information Systems Research Framework .....	61
Figure 18. Information Systems Framework of this Research .....	62
Figure 19. DSRM Process Model .....	63
Figure 20. Satisfy QoS Requirements .....	66
Figure 21. Same Source and Destination with Different Paths .....	67
Figure 22. New Backup Module .....	69
Figure 23. Network Topology 1 .....	70
Figure 24. Network Topology 2.....	72
Figure 25. QoS Parameters Example .....	77
Figure 26. Activity Diagram for the Proposed Model.....	78
Figure 27. Sequence Diagram for a Backup Request.....	81
Figure 28. Use Case Diagram for Classical Networks.....	86
Figure 29. Classical Network.....	87
Figure 30. Classical Network - Case 1 .....	89
Figure 31. Classical Network - Case 2.....	90
Figure 32. Use Case Diagram for the Proposed Approach .....	91
Figure 33. The Proposed Approach - Example .....	92
Figure 34. The Proposed Approach - Case 3 .....	93
Figure 35. The Proposed Approach - Case 4 .....	94

Figure 36. Use Case Diagram - Comparison.....	96
Figure 37. Links - Duration Chart.....	100
Figure 38. Delay - Duration Chart .....	101
Figure 39. Bandwidth - Duration Chart .....	102
Figure 40. Packet Loss Ratio - Duration Chart .....	102
Figure 41. Small Network Topology.....	105
Figure 42. Big Network Topology .....	105
Figure 43. Chart: Small Network - Small Data.....	109
Figure 44. Chart: Big Network - Small Data.....	111
Figure 45. Chart: Small Network - Medium Data.....	113
Figure 46. Chart: Big Network - Medium Data .....	115
Figure 47. Chart: Small Network - Big Data.....	117
Figure 48. Chart: Big Network - Big Data .....	119
Figure 49. AI Summary: Small Network - Small Data .....	120
Figure 50. AI Summary: Big Network - Small Data.....	120
Figure 51. AI Summary: Small Network - Medium Data.....	121
Figure 52. AI Summary: Big Network - Medium Data .....	121
Figure 53. AI Summary: Small Network - Big Data.....	121
Figure 54. AI Summary: Big Network - Big Data .....	122
Figure 55. SDN Mininet.....	135
Figure 56. Mininet.....	136

## List of Tables

Table 1. Neural Networks: Advantages and Disadvantages .....	52
Table 2. Similar Research.....	58
Table 3. Process Model of this Research.....	64
Table 4. Network-1 QoS parameters .....	71
Table 5. Network-2 QoS parameters .....	75
Table 6. Evaluation Matrix - Empty .....	106
Table 7. Results: Small Network - Small Data.....	109
Table 8. Results: Big Network - Small Data .....	111
Table 9. Results: Small Network - Medium Data .....	113
Table 10. Results: Big Network - Medium Data .....	115
Table 11. Results: Small Network - Big Data .....	117
Table 12. Results: Big Network - Big Data.....	119
Table 13. Evaluation Matrix.....	122
Table 14. Research Summary - Research Goals .....	131
Table 15. Research Summary - Research Questions.....	132
Table 16. Research Summary - Achieved Contribution.....	132