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Ammar Alsous

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





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

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Submitted by:

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*Ammar Alsous*

## **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.

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## 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                   |

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