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

Dissertation

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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.

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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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