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# A Software Defined Fog Node Based Distributed Blockchain Cloud Architecture for IoT

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# Introduction

- The internet is neither sufficiently efficient nor sufficiently scalable to deal with enormous amounts generated from IoT data.
- Massive flows of IoT data are transmitted to the cloud at high speed in order to explore valuable information in real time, it is necessary to design an efficient data-processing architecture.
- Recent research predicts that centralized clouds will be unlikely to deliver satisfactory services to customers in the near future. From the core to the edge of the network, fog computing can be viewed as a layered service structure that is an extension of the cloud computing paradigm.
- A distributed peer-to-peer decentralized cloud storage solution is required to achieve the objectives for the future IoT network.
- With blockchain technique, applications can be operated in distributed ways, whereas previously they had to pass through a trusted intermediary.

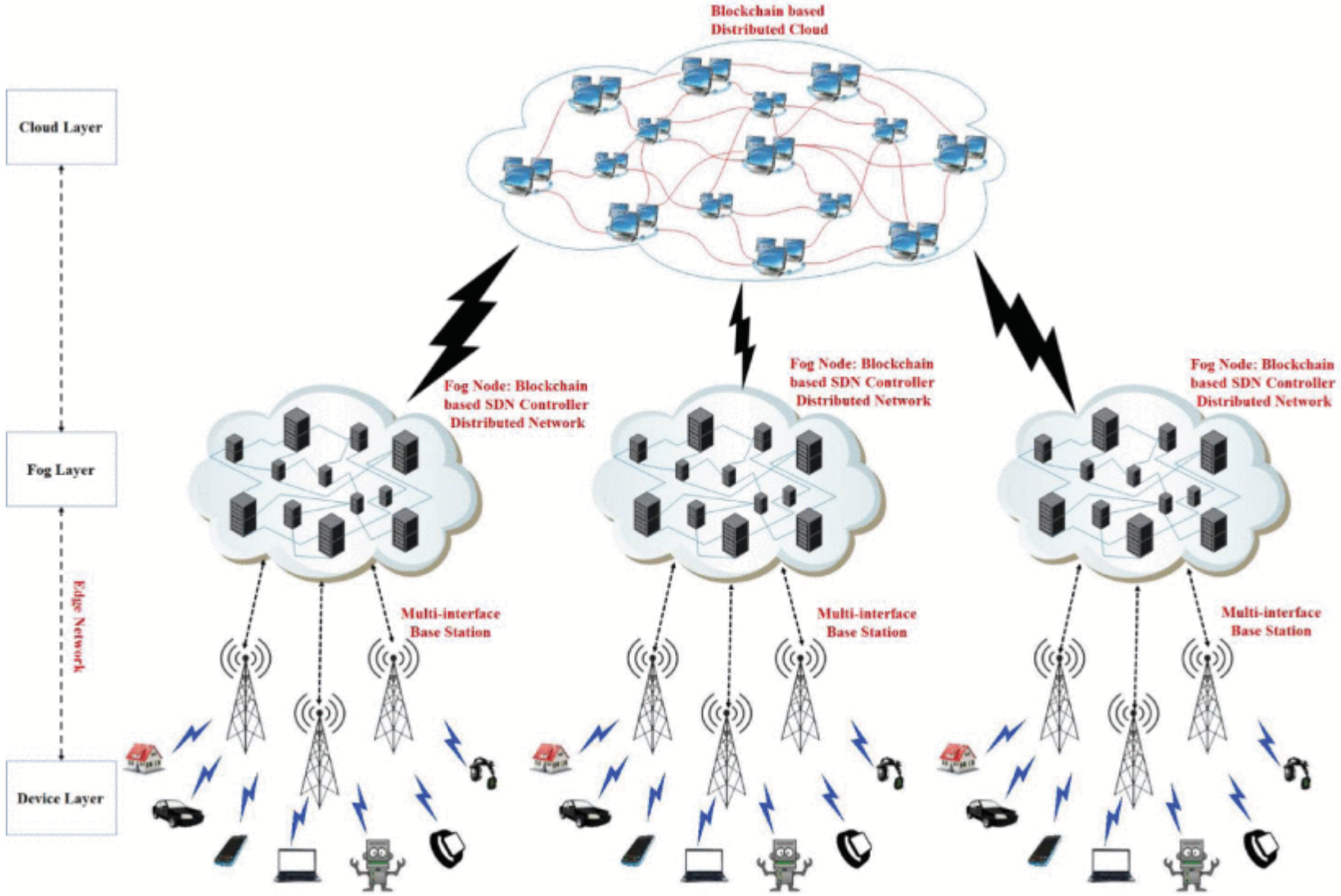
# Introduction

- The paper proposes a flexible, efficient, scalable, and securely distributed cloud architecture that uses SDN, fog computing, and a blockchain technique to gather, classify and analyze IoT data streams at the edge of the network and the distributed cloud.
- This paper proposes a distributed cloud architecture based on the blockchain technique, which provides low-cost, secure, and on-demand access to the most competitive computing infrastructures in the IoT network.
- It also proposes a secure distributed fog node architecture using SDN and blockchain techniques by bringing computing resources to the edge of the IoT network.

# Preliminaries

- The need for the blockchains technology in the distributed cloud storage:
  1. Full decentralization and true redundancy
  2. Facilitates resource usage
  3. Complete privacy
  4. Improves the Quality-of-Services
  5. Cost reduction
- To design a high-performance architecture in the edge computing scalable IoT network, the following design principles must be taken into consideration:
  1. Resilience
  2. Efficiency
  3. Ease of deployment
  4. Adaptability
  5. High availability and fault tolerance
  6. Performance
  7. Scalability
  8. Security

# Distributed Blockchain Cloud Architecture




Overview of the distributed blockchain cloud architecture

# Distributed Blockchain Cloud Architecture

- Distributed Blockchain Cloud Architecture - The proposed model consists of the following four steps:
  - In the first step, the cloud user must select the resource provider from the service provider pool in the blockchain-based distributed cloud.
  - Once the selection has been made, the selected service provider will then provide the required services, such as task execution, data management, and the provision of servers, to that user.
  - After providing the requested services, the service provider registers the transaction in the form of a blockchain and shares it with all distributed peer service providers.
  - Finally, the user will pay and reward the provider. This model reduces the cost and transparent reputation of resource providers and rewards reliable providers with an integrated quality of service controls that can provide the required level of computing resources.
- For the security of the Blockchain architecture, the following algorithms are implemented:
  1. Proof-of-Service
  2. Matchmaking Algorithm
  3. Scheduling Algorithm

# Distributed Blockchain Cloud Architecture

Edge Computing Network Architecture-

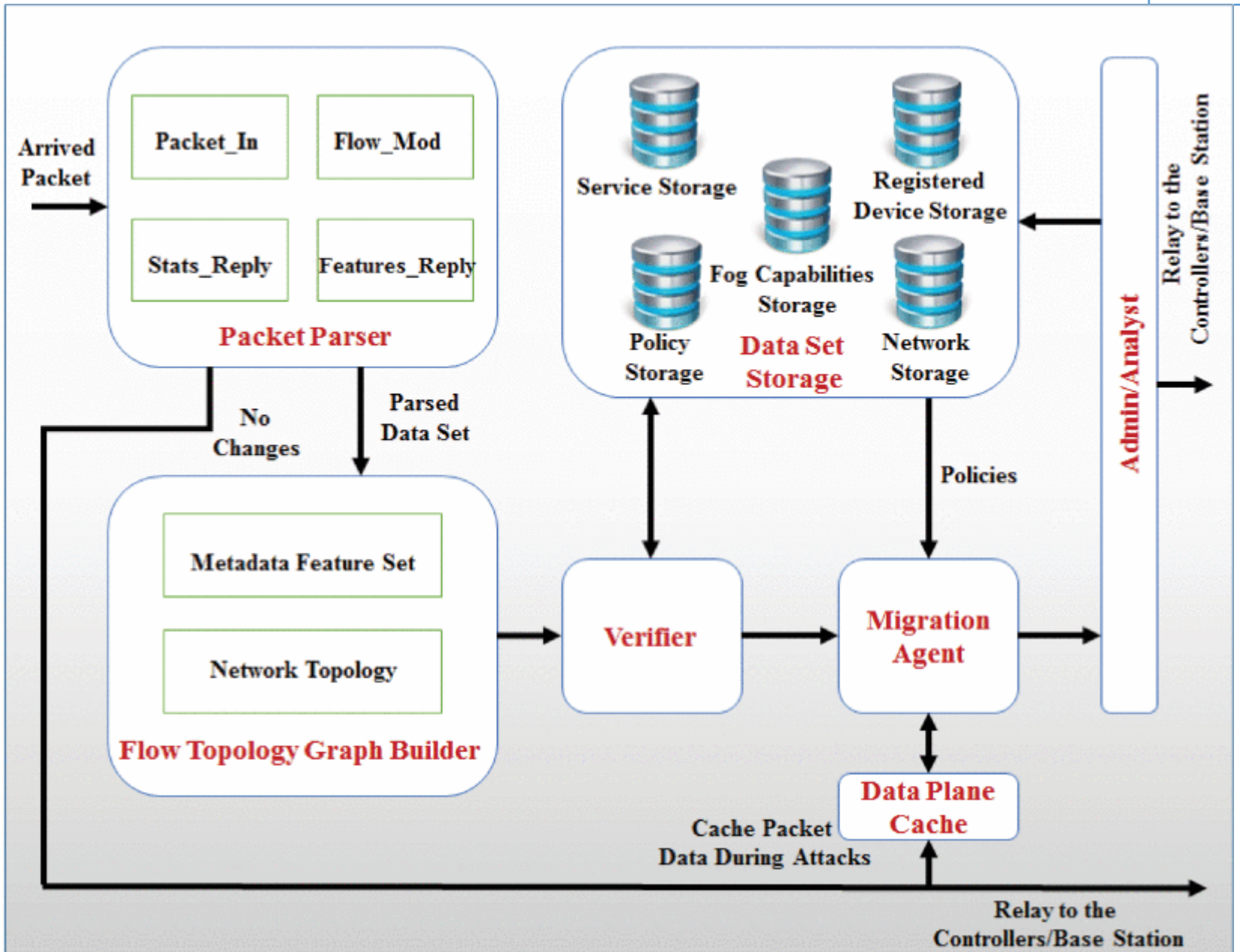
- In the edge network, all the IoT devices communication to the fog nodes happens through multi-interface Base Stations.
- BSs will consider as a gateway or as a forwarding SDN switch for the fog controller, which collects all the data from IoT devices and forwards it to the fog node controller.
- Each fog node is composed of distributed SDN controllers and uses the blockchain technique to provide scalable, reliable, and high-availability services. Each SDN controller includes packet migration and flow rule analysis functions.

# Distributed Blockchain Cloud Architecture

Edge Computing Network Architecture- The architecture of the SDN controller of the fog node in the edge network consists of three different phases.

- In the first phase, to build an overall network view, this model monitors and parses to identify essential OpenFlow messages from the arrival OpenFlow packets.
- In the second phase, it analyzes the parsed data set and extracts the routing topology state and metadata features sets to construct a network flow topology graph with the traffic flow.
- In the third phase, the metadata flow of a set validates the allowable metadata values collected over the duration of the flow and management strategies.

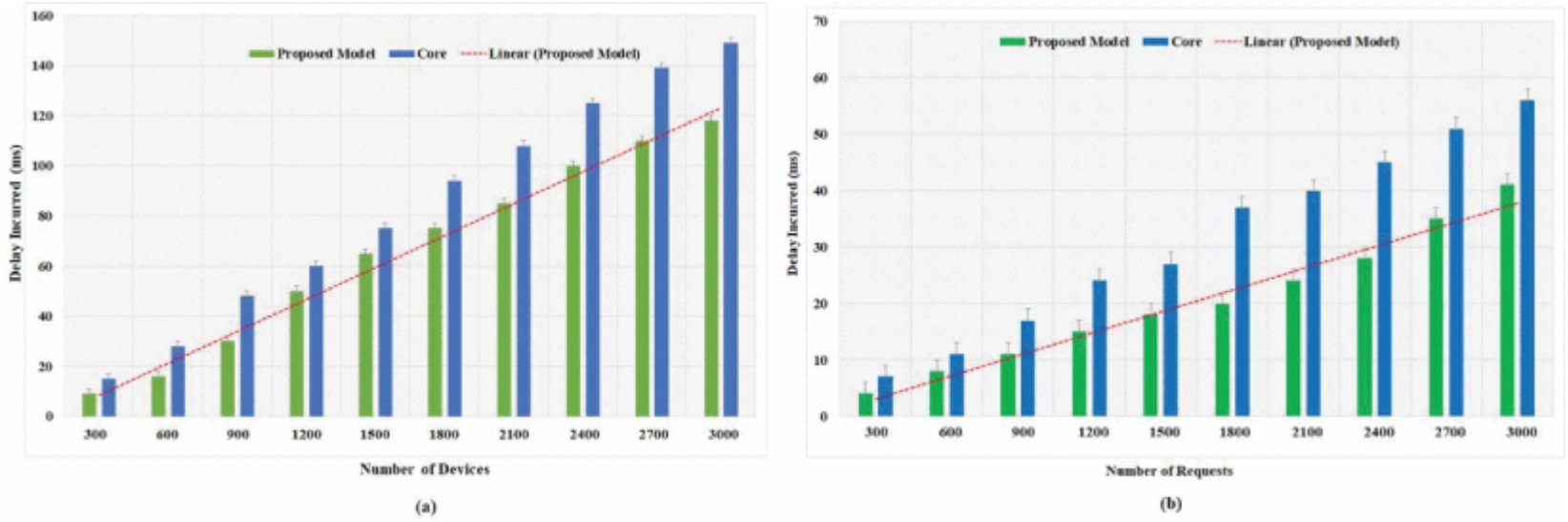
# Distributed Blockchain Cloud




Architecture of the SDN controller of the fog node in the edge network.

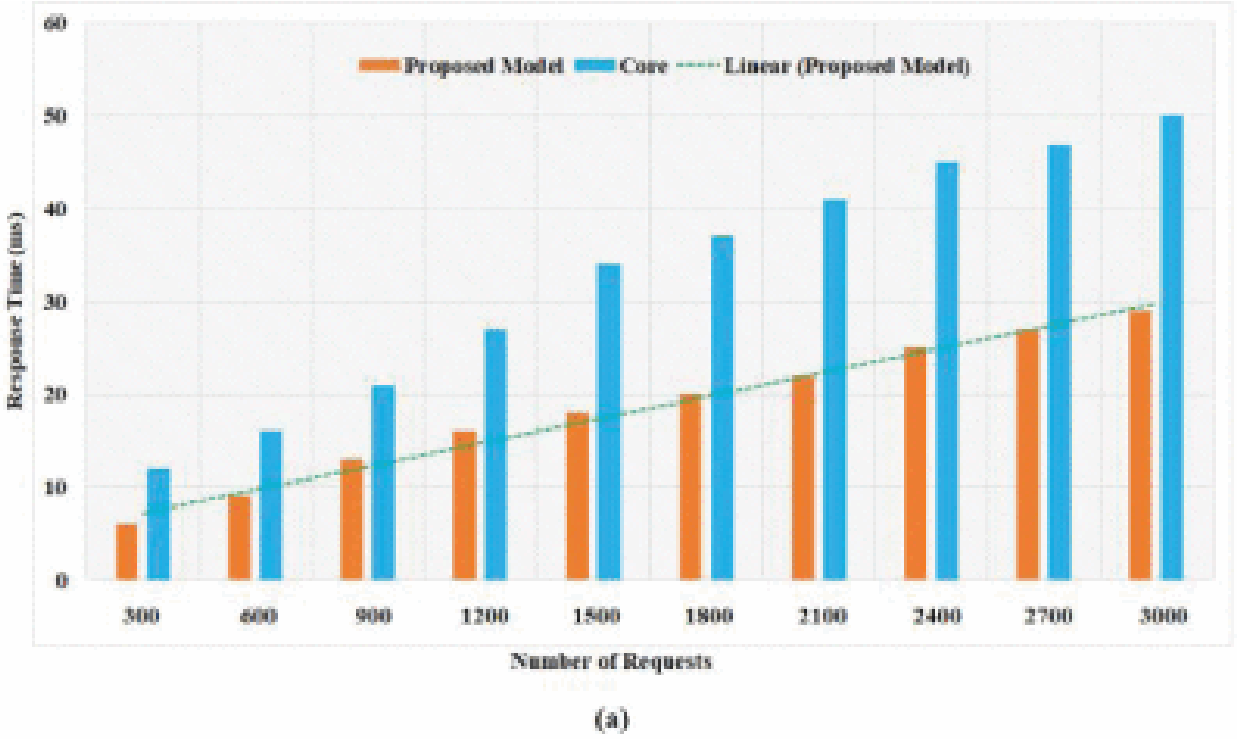
# Performance evaluation

- The proposed scheme is evaluated by using the throughput, response time and the delay-incurred performance metrics.
- The accuracy of the proposed model by measuring the speed with which it can detect and mitigate saturation attacks at the edge of the network is also evaluated.




- Delay incurred by: Fig. 3 a) an increase in the number of devices; and 3 b) an increase in the number of requests

# Performance evaluation



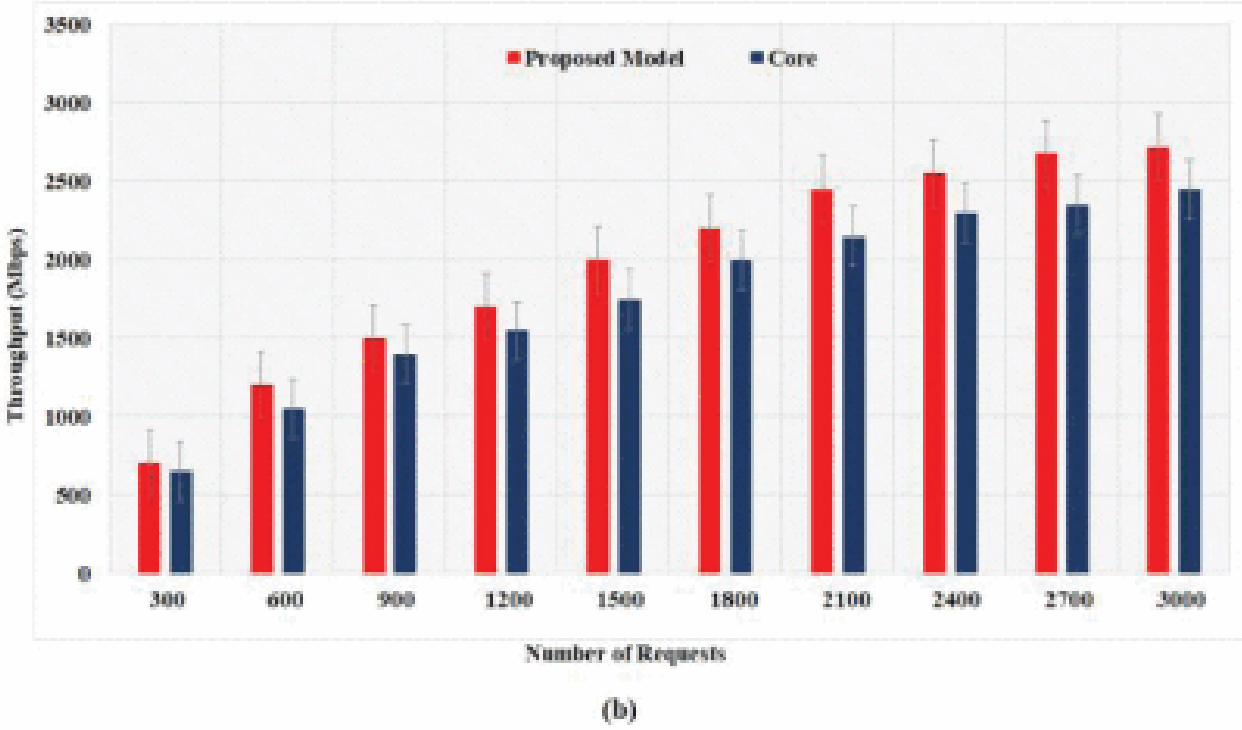
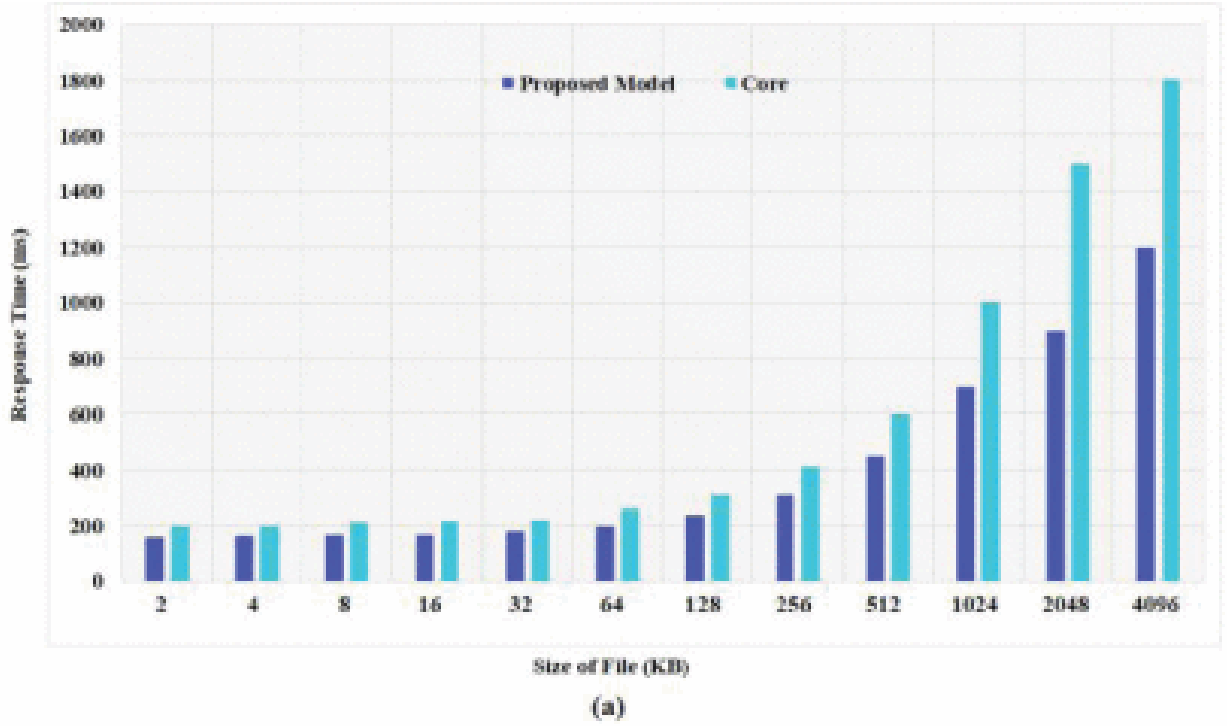
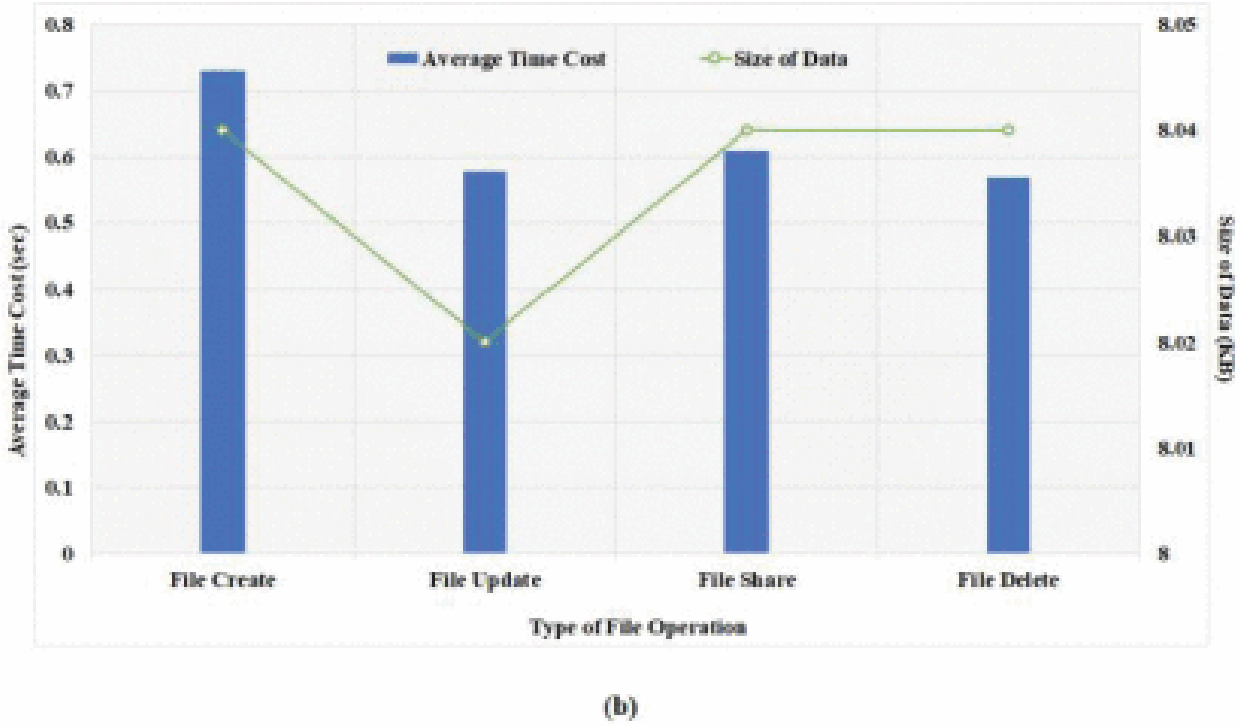




Fig. 4 a) the variation in response time; Fig. 4 b) the variation in throughput.

# Performance evaluation




File operations: Fig. a) average response time with different file size; Fig. b) average data retrieval time cost.

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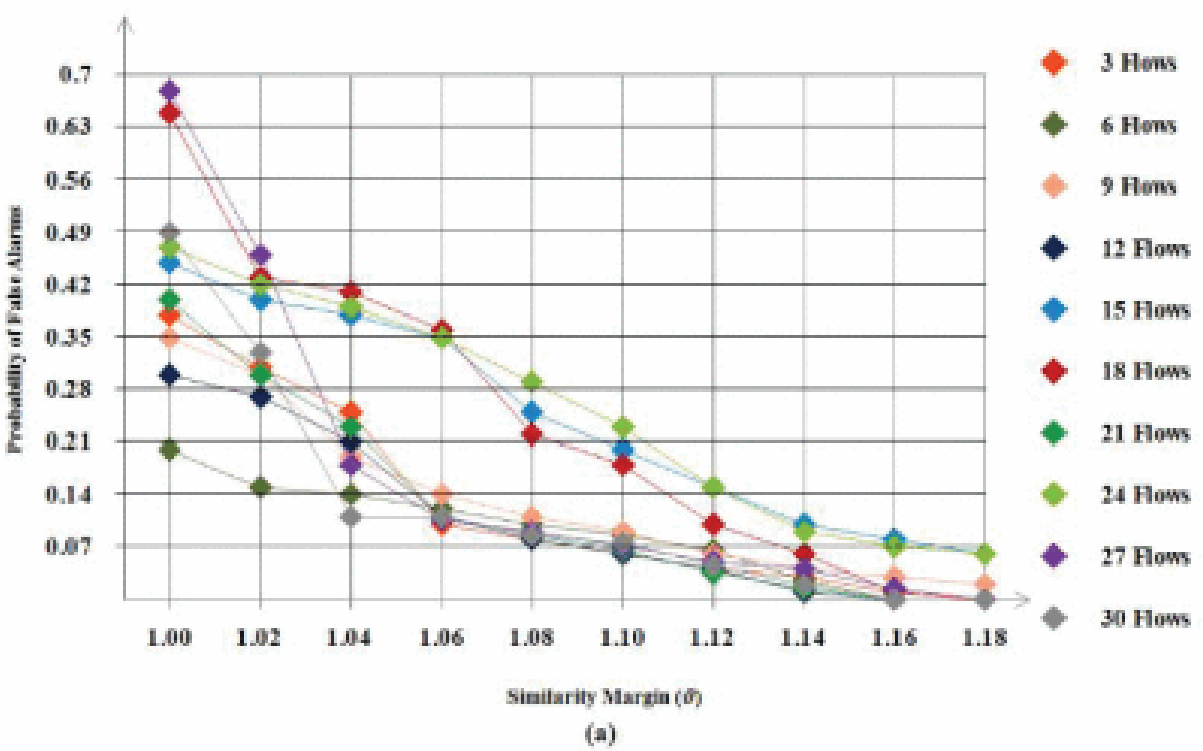
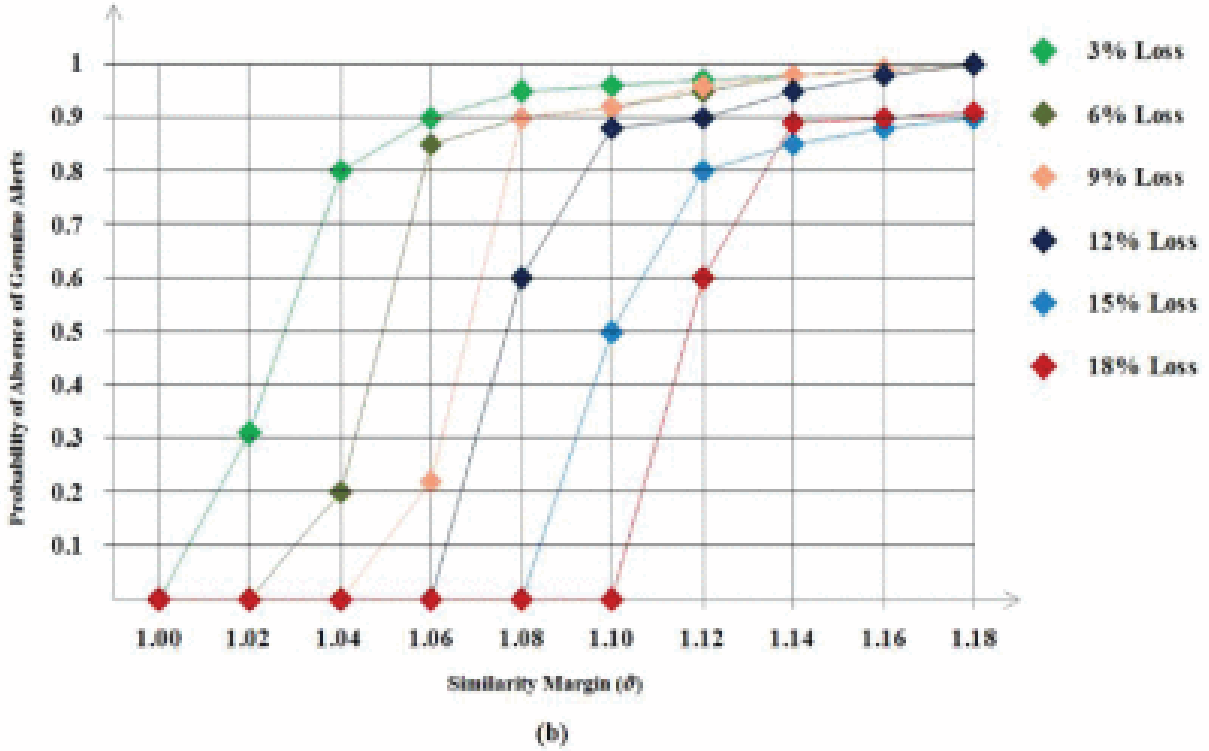
# Performance evaluation




Accuracy rate of the proposed model: a) probability of false alarms with in flows; b) probability of absence of genuine alerts vs. loss rate

# Conclusion

- This paper proposes a new distributed blockchain cloud architecture model to meet the design principles required to efficiently manage the raw data streams produced by large IoT devices in the distributed cloud and at the edge of the network.
- The proposed architecture was designed to support high availability, real-time data delivery, high scalability, security, resiliency, and low latency.
- Compared to the traditional IoT architecture, the proposed architecture can significantly reduce the end-to-end delay between IoT devices, computing resources and traffic load in the core network.

# Opinion

- The fog layer's SDN controller distributed implementation using Blockchain technology can help security concerns such as DDoS attacks where if one controller is overwhelmed with traffic, data can be streamed via other connected SDN controllers.
- The proposed system is to supplement the reliance of business users on the Cloud based storage systems. However, as the author mentions that Cloud based services are inexpensive. Amazon offers decentralized storage infrastructure on the cloud for $25 per terabyte per month.
- Users expect privacy of their data. If a company offers a blockchain based storage solution on cloud, it must be a private blockchain. The data still remains in the hands of the service providers. A private blockchain owner decides which data to approve and which to not.
- Data is growing and can blockchain based solutions offer the required scalability to store large amounts of data. Data transmission is slow on blockchain systems, enterprises depend on high-performance legacy transaction processing systems.

# Thank you