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(57) Abstract :
The invention presents a dynamic method for providing Quality of Service (QoS) in data networks. By categorizing and prioritizing data packets based on their intrinsic needs, the method ensures optimal data flow across diverse applications. It is adaptable to real-time network conditions, seamlessly integrating across different architectures and offering enhanced security provisions. Leveraging machine learning, the method continually refines QoS allocations. Designed for current and future network technologies, it incorporates user interfaces for personalized experiences and promotes energy efficiency. The invention's modular design ensures its applicability in networks of varied scales. Accompanied Drawing [FIGS. 1-2]

No. of Pages : 20 No. of Claims : 10

"**FORM 1** THE PATENTS ACT 1970 (39 of 1970) and THE PATENTS RULES, 2003 **APPLICATION FOR GRANT OF PATENT** (See section 7, 54 and 135 and sub-rule (1) of rule 20)				(FOR OFFICE USE ONLY)	
		Application No.			
		Filing date:			
		Amount of Fee paid:			
		CBR No:			
		Signature:			
1. APPLICANT'S REFERENCE / IDENTIFICATION NO. (AS ALLOTTED BY OFFICE)					
2. TYPE OF APPLICATION [Please tick (✓) at the appropriate category]					
Ordinary (✓)		Convention ( )		PCT-NP ( )	
Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )	Divisional ( )	Patent of Addition ( )
3A. APPLICANT(S)					
Name in Full		Nationality	Country of Residence	Address of the Applicant	
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3B. CATEGORY OF APPLICANT [Please tick (✓) at the appropriate category]					
Natural Person ()		Other than Natural Person			
		Small Entity (✓)	Startup ()	Others ()	
4. INVENTOR(S) [Please tick (✓) at the appropriate category]					
Are all the inventor(s) same as the applicant(s) named above?		Yes ()		No (✓)	
If "No", furnish the details of the inventor(s)					
Name in Full		Nationality	Country of Residence	Address of the Inventor	
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5. TITLE OF THE INVENTION

"A METHOD FOR PROVIDING QUALITY OF SERVICE IN A DATA NETWORK"

6. AUTHORISED REGISTERED PATENT AGENT(S)	IN/PA No.	
	Name	
	Mobile No.	
7. ADDRESS FOR SERVICE OF APPLICANT IN INDIA	Name	Prof. James Stephen Meka
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~~**8. IN CASE OF APPLICATION CLAIMING PRIORITY OF APPLICATION FILED IN CONVENTION COUNTRY, PARTICULARS OF CONVENTION APPLICATION**~~

~~Country~~	~~Application~~	~~Filing date~~	~~Name of the~~	~~Title of the~~	~~IPC (as classified in the~~

	~~Number~~		~~applicant~~	~~invention~~	~~convention country)~~

~~9. IN CASE OF PCT NATIONAL PHASE APPLICATION, PARTICULARS OF INTERNATIONAL APPLICATION FILED UNDER PATENT CO-OPERATION TREATY (PCT)~~

~~International application number~~	~~International filing date~~

~~10. IN CASE OF DIVISIONAL APPLICATION FILED UNDER SECTION 16, PARTICULARS OF ORIGINAL (FIRST) APPLICATION~~

~~Original (first) application No.~~	~~Date of filing of original (first) application~~

~~11. IN CASE OF PATENT OF ADDITION FILED UNDER SECTION 54, PARTICULARS OF MAIN APPLICATION OR PATENT~~

~~Main application/patent No.~~	~~Date of filing of main application~~

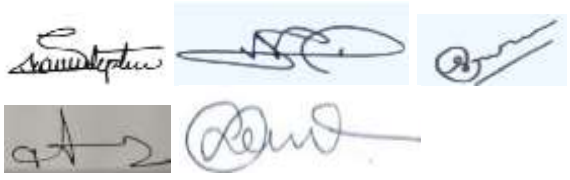
12. DECLARATIONS

i) Declaration by the inventor(s)

(**In case the applicant is an assignee**: the inventor(s) may sign herein below or the applicant may upload the assignment or enclose the assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period).

I/We, the above named inventor(s) is/are the true & first inventor(s) for this Invention and declare that the applicant(s) herein is/are my/our assignee or legal representative.

(a) Date 24/08/2023

(b) Name	(c) Signature
1. Prof. James Stephen Meka 2. Mr.Karri Nagaraju 3. Mr.Sriram Gopalam 4. Prof.Augustine Tarala 5. Dr.Praveen Babu Choppala	

~~(ii) Declaration by the applicant(s) in the convention country~~

~~(In case the applicant in India is different than the applicant in the convention country:~~ ~~the applicant in the convention country may sign herein below or applicant in India may upload the assignment from the applicant in the convention country or enclose the said assignment with this application for patent or send the assignment by post/electronic transmission duly authenticated within the prescribed period)~~

~~I/We, the applicant(s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.~~

~~(a) Date~~

~~(b) Signature(s)~~

(c) ~~Name(s) of the signatory~~

(iii) Declaration by the applicant(s)

I/We the applicant(s) hereby declare(s) that: -

- ☐ ~~I am/~~ We are in possession of the above-mentioned invention.
- ☐ The ~~provisional~~/complete specification relating to the invention is filed with this application.
- ☐ ~~The invention as disclosed in the specification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.~~
- ☐ There is no lawful ground of objection(s) to the grant of the Patent to me/us.
- ☐ ~~I am~~/we are the true & first inventor(s).
- ☐ ~~I am/we are the assignee or legal representative of true & first inventor(s).~~
- ☐ ~~The application or each of the applications, particulars of which are given in Paragraph-8, was the first application in convention country/countries in respect of my/our invention(s).~~
- ☐ ~~I/We claim the priority from the above mentioned application(s) filed in convention country/countries and state that no application for protection in respect of the invention had been made in a convention country before that date by me/us or by any person from which I/We derive the title.~~
- ☐ ~~My/our application in India is based on international application under Patent Cooperation Treaty (PCT) as mentioned in Paragraph-9.~~
- ☐ ~~The application is divided out of my /our application particulars of which is given in Paragraph-10 and pray that this application may be treated as deemed to have been filed on DD/MM/YYYY under section 16 of the Act.~~
- ☐ ~~The said invention is an improvement in or modification of the invention particulars of which are given in Paragraph-11.~~

13. FOLLOWING ARE THE ATTACHMENTS WITH THE APPLICATION

(a) Form 2

Item	Details	Fee	Remarks
Complete/ ~~Provisional~~ specification) #	No. of pages: 16		
No. of Claim(s)	No. of claims: 10 No. of pages: 02		
Abstract	No. of pages: 01		
No. of Drawing(s)	No. of drawings: 02 No. of pages: 01		

In case of a complete specification, if the applicant desires to adopt the drawings filed with his provisional specification as the drawings or part of the drawings for the complete specification under rule 13(4), the number of such pages filed with the provisional specification are required to be mentioned here.

(b) Complete specification (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(c) Sequence listing in electronic form

(d) Drawings (in conformation with the international application)/as amended before the International Preliminary Examination Authority (IPEA), as applicable (2 copies).

(e) Priority document(s) or a request to retrieve the priority document(s) from DAS (Digital Access Service) if the applicant had already requested the office of first filing to make the priority document(s) available to DAS.

(f) Translation of priority document/Specification/International Search Report/International Preliminary Report on Patentability.

(g) Statement and Undertaking on Form 3

(h) Declaration of Inventorship on Form 5

(i)Power of Authority

(j)**Total fee ₹…….in Cash/ Banker's Cheque /Bank Draft bearing No..... Date on ……. Bank.**

I/We hereby declare that to the best of my/our knowledge, information and belief the fact and matters slated herein are correct and I/We request that a patent may be granted to me/us for the said invention.

Dated this 24th day of August 2023

Applicant: Andhra University

To,

The Controller of Patents

The Patent Office, at Chennai

Note: -

* Repeat boxes in case of more than one entry.
* To be signed by the applicant(s) or by authorized registered patent agent otherwise where mentioned.
* Tick ()/cross (x) whichever is applicable/not applicable in declaration in paragraph-12.
* Name of the inventor and applicant should be given in full, family name in the beginning.
* Strike out the portion which is/are not applicable.
* For fee: See First Schedule";

FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

&

The Patent Rules, 2003

COMPLETE SPECIFICATION

(See section 10 and rule 13)

TITLE OF THE INVENTION

"A METHOD FOR PROVIDING QUALITY OF SERVICE IN A DATA NETWORK"

Applicant

NAME	**NATIONALITY**	**ADDRESS**
Andhra University	Indian	Visakhapatnam, Andhra Pradesh, India. Pin Code: 530003

The following specification particularly describes the nature of the invention and the manner in which it is performed:

FIELD OF THE INVENTION

[001] The present invention relates generally to data networks, and more specifically to a method for ensuring and managing the quality of service (QoS) in such networks. The invention addresses the need to prioritize, control, and optimize network traffic to guarantee a certain level of performance or quality for various types of data services and applications. This pertains to both wired and wireless data networks and can be applied across diverse network architectures and protocols.

BACKGROUND OF THE INVENTION

[002] The following description provides the information that may be useful in understanding the present invention. It is not an admission that any of the information provided herein is prior art or relevant to the presently claimed invention, or that any publication specifically or implicitly referenced is prior art.

[003] Further, the approaches described in this section are approaches that could be pursued, but not necessarily approaches that have been previously conceived or pursued. Therefore, unless otherwise indicated, it should not be assumed that any of the approaches described in this section qualify as prior art merely by virtue of their inclusion in this section.

[004] The increasing dependence on data networks for both professional and personal communication has led to a surge in network traffic. These networks, which span the globe and are responsible for carrying vast amounts of data, range from local area networks (LANs) in offices to wide area networks (WANs) that connect countries and continents. The emergence of various data-intensive applications, such as high-definition video streaming, online gaming, virtual

reality, cloud computing, and Internet of Things (IoT) devices, to name a few, have placed an unprecedented demand on these networks.

[005] Historically, many networks were designed primarily for the transmission of textual data or low-resolution media. However, the modern user requires a network that can handle diverse types of data, with differing needs in terms of speed, reliability, and latency. For example, while downloading a large file might tolerate minor interruptions or slowdowns, a video call or online gaming session is highly sensitive to such disturbances. Similarly, an IoT device sending periodic updates requires a different level of service compared to a critical telemedicine application that demands real-time high-quality video and data transfer.

[006] This diverse nature of network applications and their varying requirements posed a challenge. Network service providers and enterprises faced difficulties ensuring that each application and user received the necessary quality of service, especially during peak times or network congestion. The challenges were exacerbated by the fact that traditional networking equipment and protocols did not natively support fine-grained quality of service controls. As a result, without proper QoS management, networks often faced situations where non-critical data transmissions could overshadow and degrade the performance of more critical tasks.

[007] Additionally, as businesses and services became more global, there arose a need for standardized methods to ensure that QoS is maintained not just within a single network but across interconnected networks. This continuity was essential to ensure that users and applications received a consistent experience regardless of their location or the networks they traversed.

In light of these challenges, there was a pressing need for a method that would allow network administrators and service providers to ensure that different types of data traffic were treated appropriately, ensuring that each service received the necessary bandwidth, priority, and other resources to function optimally. This method would ideally be scalable, adaptable, and efficient in catering to the evolving needs of modern data networks. The present invention seeks to address these challenges by introducing a novel method for providing quality of service in a data network.

[008] The need for a method to provide quality of service (QoS) in data networks was further intensified by the proliferation of mobile devices and the rapid expansion of 4G and 5G technologies. As users became more mobile, the demand for consistent and high-quality data services on-the-go soared. This meant that networks weren't just dealing with the challenge of stationary users; they were now tasked with ensuring seamless service quality for users in transit, transitioning between network nodes, or even across different types of networks.

[009] The emergence of edge computing brought in another layer of complexity. As more data processing began to occur closer to the data source, be it smart cars, wearables, or industrial sensors, the emphasis shifted from just moving large volumes of data to ensuring timely processing and transmission of this data. Delays, which might be acceptable in some conventional applications, could result in significant problems, like in the case of autonomous vehicles where real-time data processing and decision-making are critical.

[010] There was also a significant shift in the architectural paradigms of many networks. The transition from monolithic, centralized systems to more

decentralized, cloud-native infrastructures demanded that QoS methods be adaptable and dynamic. Network functions virtualization (NFV) and software-defined networking (SDN) started gaining traction as solutions to make networks more flexible and programmable. These approaches highlighted the need for a QoS method that could be easily integrated into software-driven architectures, allowing for real-time adjustments based on network conditions, user demand, and application requirements.

[011] On the consumer front, users' expectations began to shift dramatically. With the rise of streaming services, online multiplayer games, and other real-time applications, the average consumer was no longer content with just having a connection. They demanded a high-quality experience, free from lags, buffering, or dropped connections. Service providers who couldn't ensure this level of QoS faced potential loss of customers and revenue.

[012] Security concerns also played a role in the push for better QoS methods. As cyber threats evolved, networks faced the dual challenge of ensuring service quality while simultaneously combating various threats. Denial of Service (DoS) and Distributed Denial of Service (DDoS) attacks, in particular, aimed to flood networks with unwanted traffic, disrupting services. A robust QoS system needed to distinguish between legitimate high-volume traffic and potential threat traffic, ensuring that genuine users weren't affected during such attacks.

[013] In light of all these developments, the need for a sophisticated, dynamic, and adaptable method for ensuring QoS became paramount. The present invention, in recognizing these multifaceted challenges, endeavors to offer a solution that not only addresses current network demands but is also forward-

looking, anticipating the future evolutions of data networks. Some patent prior art related to proposed invention mention below.

[014] Title: Method and system for providing quality-of-service in a data-over-cable system

Abstract: The patent relates to a method and system to provide QoS in a cable modem termination system (CMTS). This system takes into account both the cable modem's capabilities and the user's subscription level to determine the QoS parameters. While it does not cover data networks broadly, it highlights a specific method for cable data systems.

Relevance: High for cable-based data networks but may not be directly applicable to other types of networks.

[015] Title: Quality of service (QoS) management in a distributed environment

Abstract: This patent describes methods for managing QoS in a distributed computing environment. It involves receiving a QoS requirement, translating the requirement into a policy, and then distributing this policy to multiple network devices. This method ensures that the QoS is maintained across the distributed network.

Relevance: High for distributed data networks and offers a broader approach than cable-specific systems.

[016] Title: Dynamic adjustment of quality of service (QoS) based on real-time network conditions

Abstract: This invention emphasizes adjusting QoS dynamically based on real-time network conditions. It measures network metrics continuously and modifies the QoS parameters in real time based on these metrics, ensuring optimal service delivery regardless of network conditions.

Relevance: Highly relevant, especially for networks experiencing variable traffic and unpredictable conditions.

[017] Title: Quality of service provisioning for mobile devices

Abstract: This patent focuses on providing QoS for mobile devices. It proposes a method where the mobile device communicates its QoS requirements to the network, which then adjusts its parameters to meet these requirements, ensuring a consistent experience for mobile users.

Relevance: Highly relevant for networks serving mobile devices and emphasizes user-device initiated QoS adjustments.

[018] Title: Software-defined networking (SDN) based quality of service (QoS) management

Abstract: This invention relates to using SDN for QoS management. It involves a centralized controller that manages QoS for multiple network devices. The controller receives QoS requirements from applications, translates them into policies, and deploys these policies to the network devices via SDN techniques.

Relevance: Highly relevant for modern data networks transitioning to or already utilizing SDN architectures.

[019] In this respect, before explaining at least one object of the invention in detail, it is to be understood that the invention is not limited in its application to the details of set of rules and to the arrangements of the various models set forth in the following description or illustrated in the drawings. The invention is capable of other objects and of being practiced and carried out in various ways, according to the need of that industry. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[020] These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

SUMMARY OF THE PRESENT INVENTION

[021] The proposed invention offers a method to provide and manage Quality of Service (QoS) in data networks. Recognizing the growing demands of diverse applications, from high-definition streaming to real-time gaming and IoT device communications, the method ensures that each type of data traffic receives appropriate treatment to function optimally within the network. This includes allocating necessary bandwidth, prioritizing certain data packets, and dynamically adjusting network resources based on real-time conditions. The invention addresses challenges brought about by mobile users, edge computing, and evolving cyber threats, seamlessly integrating into modern, software-driven network architectures. By dynamically adjusting to network conditions and application needs, the invention offers a comprehensive solution to deliver consistent and high-quality data services across various network architectures and protocols.

[022] In this respect, before explaining at least one object of the invention in detail, it is to be understood that the invention is not limited in its application to the details of set of rules and to the arrangements of the various models set forth in the following description or illustrated in the drawings. The invention is

capable of other objects and of being practiced and carried out in various ways, according to the need of that industry. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of description and should not be regarded as limiting.

[023] These together with other objects of the invention, along with the various features of novelty which characterize the invention, are pointed out with particularity in the disclosure. For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be made to the accompanying drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[024] When considering the following thorough explanation of the present invention, it will be easier to understand it and other objects than those mentioned above will become evident. Such description refers to the illustrations in the annex, wherein:

[025] FIG. 1, illustrates a general functional working diagram, in accordance with an embodiment of the present invention.

[026] FIG. 2, illustrates a concept of the functional flow diagram, accordance with an embodiment of the present invention.in accordance with an embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[027] The following sections of this article will provide various embodiments of the current invention with references to the accompanying drawings, whereby the reference numbers utilised in the picture correspond to like elements

throughout the description. However, this invention is not limited to the embodiment described here and may be embodied in several other ways. Instead, the embodiment is included to ensure that this disclosure is extensive and complete and that individuals of ordinary skill in the art are properly informed of the extent of the invention.

[028] Numerical values and ranges are given for many parts of the implementations discussed in the following thorough discussion. These numbers and ranges are merely to be used as examples and are not meant to restrict the claims' applicability. A variety of materials are also recognised as fitting for certain aspects of the implementations. These materials should only be used as examples and are not meant to restrict the application of the innovation.

[029] Referring now to the drawings, these are illustrated in FIG. **1**&**2,** In The invention presents a novel method for managing and providing Quality of Service (QoS) in data networks, ensuring optimal performance and user experience. In the age of digital transformation, networks are burdened with a wide array of data types, each with its unique requirements concerning speed, latency, and reliability. The conventional one-size-fits-all approach to data management has proven insufficient in catering to these varied demands. This invention seeks to fill this gap by introducing a sophisticated system that meticulously tailors the treatment of data packets based on their intrinsic needs. At its core, the invention is rooted in a dynamic algorithm that continually assesses the nature of the data being transmitted and its associated priority. For instance, a video conference call would naturally demand low latency and high reliability, ensuring smooth and uninterrupted communication. In contrast,

an email or file download, though important, can tolerate minor delays without significantly impacting the user experience. The system, through an intelligent assessment mechanism, categorizes these data packets, ensuring that real-time or high-priority data is treated with urgency, while less time-sensitive data is queued appropriately.

[030] Furthermore, the invention is adept at adapting to fluctuating network conditions. Recognizing that network congestion, maintenance activities, or unexpected outages are inevitable, the invention's algorithm is designed to reallocate resources swiftly. This ensures that during peak times or unexpected disruptions, critical services remain largely unaffected, and any degradation in service is evenly distributed and minimized.

[031] Another key feature of the invention is its capability to seamlessly integrate and function across various network architectures, from traditional wired setups to modern wireless configurations and even hybrid systems. Whether the data is traversing a local area network in an office setting or being beamed across continents through satellite links, the invention ensures consistent QoS management.

[032] The invention also incorporates provisions for security. In an era where cyber threats are ever-evolving, ensuring QoS isn't just about managing data flow but also about distinguishing legitimate traffic from potential threats. The system has built-in mechanisms to identify and mitigate unusual traffic patterns, ensuring that genuine users and critical applications remain shielded from potential disruptions caused by malicious activities.

[033] Furthermore, with the rise of edge computing and the Internet of Things (IoT), the invention is forward-compatible, designed to cater to the burgeoning

demand for real-time data processing close to the source. Whether it's an autonomous vehicle relying on split-second data processing or a wearable device transmitting health metrics, the invention guarantees consistent, high-quality data services.

[034] Lastly, acknowledging the global nature of modern business and communication, the invention is not limited by geographical boundaries. Its design ensures that whether data is being accessed locally or from a server thousands of miles away, the QoS remains consistent, offering users a uniform experience.

[035] While the core functions of the invention have been elaborated, it is crucial to highlight its adaptability and scalability aspects. As the digital landscape evolves, so too does the diversity of devices that connect to the network. From smartphones and laptops to smart refrigerators and industrial sensors, the sheer volume and variety of devices connecting to networks today are staggering. The invention acknowledges this device heterogeneity and is constructed to understand the unique QoS needs of each device type.

[036] Another integral component of the invention is its ability to learn and evolve using advanced machine learning techniques. Over time, by analysing network traffic patterns, user behavior, and device interactions, the system optimizes its decision-making processes, leading to even more refined QoS allocations. This self-improving mechanism ensures that the invention remains efficient and relevant, adapting to emerging technologies and user behaviors.

[037] In the context of a world that is fast moving towards 5G and beyond, the demands on data transmission speeds, low latency, and network reliability are only set to increase. The invention's framework has been designed keeping

these future advancements in mind. It's capable of harnessing the high-speed potentials of advanced networks while ensuring that even in such rapid transmission environments, the QoS remains uncompromised.

[038] A notable feature of the invention is its user-centric approach. While it operates predominantly in the background, ensuring seamless data flow, it also provides interfaces for network administrators and end-users. Administrators can set overarching policies, prioritize certain services, or allocate dedicated bandwidths for specific applications. Meanwhile, end-users are offered a dashboard to get insights into their data usage patterns, and if necessary, set their own QoS preferences for specific applications.

[039] The environmental impact of data centers and network operations is a growing concern. By optimizing data flow and ensuring efficient bandwidth utilization, the invention indirectly contributes to energy savings. Efficient data management means that network equipment and servers work optimally, reducing the energy expenditure and, consequently, the carbon footprint of digital operations.

We Claim:

1. A method for dynamically managing and providing Quality of Service (QoS) in a data network, wherein said method categorizes data packets based on their intrinsic needs and prioritizes their transmission accordingly.
2. The method of claim 1, wherein said categorization involves an algorithmic assessment of data types, including but not limited to video, audio, real-time communication, file transfer, and browsing data.
3. The method of claim 1, further comprising the reallocation of network resources in response to real-time network conditions such as traffic volume, network maintenance activities, or unexpected outages.
4. The method of claim 1, wherein it seamlessly integrates across various network architectures including wired, wireless, and hybrid configurations.
5. The method of claim 1, further comprising security provisions that enable the distinction between legitimate traffic and potential threats, thereby safeguarding genuine users from disruptions caused by malicious activities.
6. The method of claim 1, wherein it incorporates machine learning techniques to optimize QoS allocations based on historical network traffic patterns, user behaviors, and device interactions.
7. The method of claim 1, adaptable to advanced network technologies including 5G and beyond, ensuring consistent QoS despite increased data transmission speeds and demands.
8. The method of claim 1, further comprising a user interface allowing network administrators to set overarching policies and end-users to gain insights into their data usage patterns.

9. The method of claim 1, wherein the implementation leads to efficient bandwidth utilization, thereby indirectly contributing to energy savings and reduced carbon footprint.

10. A method as in any of the preceding claims, designed with scalability in mind, suitable for application in networks ranging from massive corporate infrastructures to smaller local networks.

Dated this 24th day of August 2023

Applicant

Andhra University

ABSTRACT

A METHOD FOR PROVIDING QUALITY OF SERVICE IN A DATA NETWORK

[040] The invention presents a dynamic method for providing Quality of Service (QoS) in data networks. By categorizing and prioritizing data packets based on their intrinsic needs, the method ensures optimal data flow across diverse applications. It is adaptable to real-time network conditions, seamlessly integrating across different architectures and offering enhanced security provisions. Leveraging machine learning, the method continually refines QoS allocations. Designed for current and future network technologies, it incorporates user interfaces for personalized experiences and promotes energy efficiency. The invention's modular design ensures its applicability in networks of varied scales.

Accompanied Drawing **[FIGS. 1-2]**

Dated this 24th day of August 2023

Applicant

Andhra University

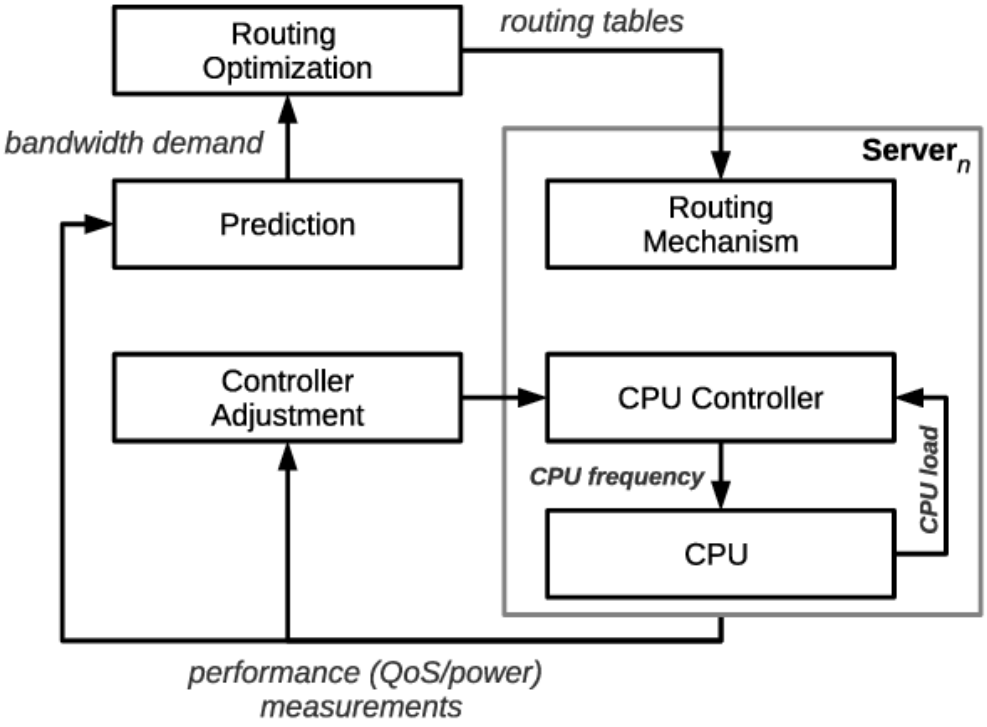


Figure 1

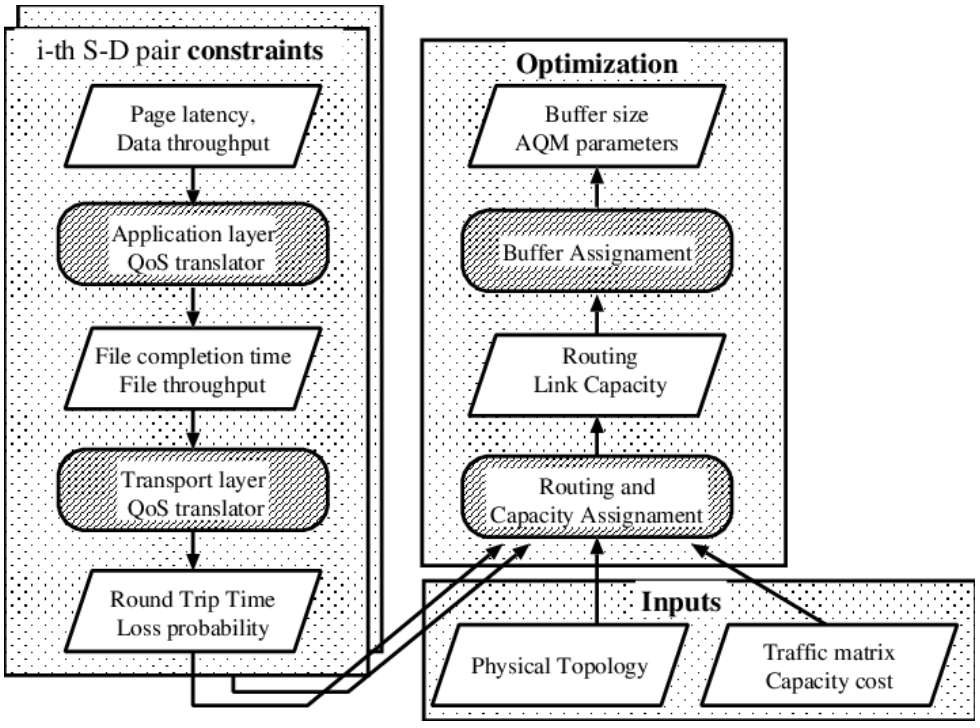


Figure 2

Dated this 24th day of August 2023