# Enhancing Cloud-Based Task Scheduling: A Novel Approach Integrating Named Data Network And Smart Contracts For Optimal Blockchain Network Selection

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**Abstract:** The optimization in task scheduling within a network system in computational resources is utilized to execute a collection of tasks with varying computational requirements. The existing system operates in a networking environment, where tasks compete for execution across machines with differing execution times. The scheduling problem is formulated as a model focusing on the minimizing makespan known to be the total time spent on task execution. In proposing an enhanced system, introduce a novel approach involving a Named Data Network (NDN) coupled with smart contracts for task scheduling by selecting optimal Blockchain network. The envisioned system aims to leverage the benefits of NDN architecture and smart contract technology to optimize the assignment of tasks to machines within the cloud environment. By employing a non-preemptive scheduling model and considering a range of task properties, including execution time and machine suitability, the proposed system seeks to enhance the efficiency and effectiveness of task scheduling. The task Scheduling Problem emphasizes the importance of minimizing makespan as a key metric. The proposed Named Data Network with smart contracts introduces a paradigm shift in task scheduling, offering a potential solution to the challenges posed by the dynamic nature of task scheduling environments and the need for efficient block selection in Blockchain allocation. Through the formalization of the existing model, this research contributes to the ongoing discourse on optimal task scheduling strategies within complex computational environments.

**Keywords**: Task Scheduling Optimization, Named Data Network (NDN) Architecture, Smart Contracts for Task Allocation, Non-pre-emptive Scheduling Model, Blockchain Network Selection, Makespan Minimization

## I. INTRODUCTION

Named Data Networking (NDN) represents a groundbreaking paradigm shift in data distribution architectures, moving away from the traditional host-centric model to a more content-centric approach [1]. At its core, NDN is designed to address the challenges associated with data retrieval and dissemination in modern networking environments. The fundamental concept underlying NDN is to treat data as a first-class citizen, assigning a unique name to each piece of content rather than relying solely on IP addresses [2]. This content-centric model allows for a more efficient and scalable distribution of data, as users can request information by specifying the desired content rather than the location or host providing it [3].

In technical terms, the NDN architecture operates on the principle of Interest and Data packets. When a consumer expresses interest in a particular piece of content, an Interest packet is broadcasted across the network [4]. Routers within the NDN architecture then forward this Interest packet based on the content's name, creating an efficient and dynamic routing mechanism. Once the Interest packet reaches the node with the requested content, a corresponding Data packet is sent back along the reverse path, fulfilling the consumer's request [5]. This process, known as in-network caching, enables content retrieval from the nearest available source, promoting both reduced latency and enhanced network efficiency. NDN introduces a layer of security and trust in data distribution through the use of cryptographic signatures. Each Data packet is signed by the content producer, ensuring the integrity and authenticity of the data [6]. This cryptographic approach not only safeguards against unauthorized modifications but also establishes a secure and verifiable data distribution framework.

In formal contexts, NDN serves as a promising solution for data distribution challenges, providing a robust, scalable, and secure architecture. Its content-centric design aligns with the evolving demands of modern applications and services, facilitating efficient information retrieval and dissemination in distributed and dynamic environments [7]. As the networking landscape continues to evolve, NDN stands out as a compelling paradigm that holds the potential to revolutionize the way data is distributed and accessed across diverse platforms and applications. Blockchain technology, a revolutionary advancement in distributed systems, is characterized by its decentralized and tamper-resistant nature. At its core, a Blockchain is a distributed ledger that records transactions across a network of computers in a secure and transparent manner. The key innovation lies in its ability to create a chronological chain of blocks, each containing a list of transactions [8]. This decentralized ledger ensures transparency, immutability, and trust among participants, eliminating the need for a central authority to validate or authenticate transactions.

In technical terms, a Blockchain comprises a chain of blocks, where each block includes a cryptographic hash of the previous block, creating a linked and unbroken sequence. The use of cryptographic hashing ensures the integrity of the data and makes it computationally infeasible to alter past transactions [9]. Moreover, consensus mechanisms, such as Proof of Work (PoW) or Proof of Stake (PoS), are employed to validate transactions and add new blocks to the chain. PoW relies on complex mathematical puzzles that miners must solve to validate transactions, while PoS selects validators based on the amount of crypto currency they hold.

Smart contracts, another integral component of Blockchain technology, are self-executing contracts with the terms directly written into code [10]. These contracts automate and enforce the execution of predefined rules, eliminating the need for intermediaries and enhancing the efficiency and transparency of agreements. Smart contracts run on Blockchain platforms like Ethereum, which extends the capabilities of Blockchain beyond simple transactions, allowing for the creation of decentralized applications. Blockchain technology has profound implications for various industries, including finance, supply chain, healthcare, and more [11]. Its decentralized and secure nature fosters a trustless environment, reducing the reliance on central authorities and mitigating the risk of fraud. As organizations continue to explore and adopt Blockchain solutions, the technology's potential to reshape traditional processes and enhance security remains a focal point in discussions surrounding the future of digital transactions and decentralized systems.

## II. LITERATURE SURVEY

In their 2018 survey, titled "A survey on security and privacy issues of Bitcoin," M. Conti, S. Kumar, C. Lal, and S. Ruj meticulously examine the security and privacy aspects associated with the widely used cryptocurrency, Bitcoin [12]. The authors delve into the cryptographic principles supporting Bitcoin's security architecture, exploring potential vulnerabilities and privacy challenges inherent in its transactions and underlying technology. The survey provides a comprehensive overview of the intricate issues surrounding Bitcoin, drawing on existing literature and research findings to contribute valuable insights into the evolving state of security and privacy considerations within the Bitcoin ecosystem [13]. This work stands as a significant resource for researchers, practitioners, and stakeholders seeking a nuanced understanding of the security and privacy dimensions of this ubiquitous cryptocurrency.

In BlockNDN: A Bitcoin Blockchain Decentralized System Over Named Data Networking authored by T. Jin, X. Zhang, Y. Liu, and K. Lei, presented at the Ninth International Conference on Ubiquitous and Future Networks (ICUFN) in 2017, the authors introduce BlockNDN as an innovative system that amalgamates Bitcoin Blockchain technology with Named Data Networking (NDN) [14]. The study addresses the integration challenges of deploying a decentralized system based on the principles of Bitcoin Blockchain over the NDN architecture [15]. The authors explore the potential synergy between these two technologies, aiming to leverage the inherent strengths of NDN, such as name-based routing and in-network caching, for enhancing the efficiency of a decentralized Blockchain system. Through a detailed analysis, the paper contributes insights into the design and functionality of BlockNDN, shedding light on how it adapts and utilizes NDN's unique features to improve the delivery and management of Blockchain data [16]. The research serves as a valuable resource for understanding the intricacies of merging Blockchain and NDN technologies, providing a foundation for further exploration in the evolving landscape of decentralized systems [17].

In the technical report titled "Enabling Blockchain Applications Over Named Data Networking" authored by J. Guo, M. Wang, B. Chen, S. Yu, H. Zhang, and Y. Zhang, published by the Michigan Tech Computer Science Department in 2019, the authors investigate the integration of Blockchain applications with Named Data Networking (NDN) [18]. The report delves into the challenges and opportunities presented by the convergence of these two technologies, aiming to facilitate the deployment of Blockchain applications in the context of NDN. The authors explore novel solutions and propose mechanisms to overcome the inherent incompatibilities between traditional Blockchain systems and NDN's design, which typically relies on a "pull" mechanism. By addressing the real-time broadcasting requirements of Blockchain applications, the report introduces innovative approaches to enable efficient data delivery over NDN, such as Interest broadcasting for transactions and a subscription-push model for broadcasting Blockchain blocks [19]. This work contributes to the literature by offering insights into the adaptation of Blockchain applications to the NDN environment, providing a foundation for further research and development in the intersection of Blockchain and named data networking [20].

In the study titled "Decentralizing Privacy: Using Blockchain to Protect Personal Data," authored by G. Zyskind and O. Nathan, presented at the Security and Privacy Workshops (SPW) hosted by IEEE in 2015, the authors explore the potential of Blockchain technology as a means to enhance privacy protection for personal data [21]. The paper investigates the decentralization of privacy mechanisms by leveraging the inherent characteristics of Blockchain, such as immutability, transparency, and distributed consensus. By analyzing the applications of Blockchain in the context of privacy preservation, the authors contribute to the discourse on emerging solutions to safeguard sensitive information in an increasingly interconnected digital landscape [22]. The study is situated within the broader context of utilizing Blockchain beyond its traditional applications in financial transactions and cryptocurrencies. The insights presented in this work provide a foundation for further research into the intersection of Blockchain technology and privacy, offering a forward-looking perspective on how decentralized systems can play a pivotal role in securing personal data [23].

The Adaptive Forwarding in Named Data Networking by C. Yi, A. Afanasyev, L. Wang, B. Zhang, and L. Zhang, published in the pivotal contribution to the emerging field of Named Data Networking (NDN) [24]. This literature survey aims to contextualize and evaluate the significance of the research within the broader landscape of content-centric networking. The authors delve into the challenges of NDN, a paradigm shift from traditional host-centric communication models to a content-centric approach. By proposing adaptive forwarding strategies, the paper addresses critical issues related to efficient content retrieval and dissemination. The survey explores how the adaptive mechanisms introduced by the authors optimize data delivery in NDN by dynamically adjusting forwarding strategies based on network conditions and content popularity [25]. This work not only serves as a foundational piece in understanding the intricacies of NDN but also contributes valuable insights into the development of adaptive strategies, influencing subsequent research in content-centric networking architectures. This provides a reputable platform for disseminating this research, further solidifying its significance in the academic community [26].

## III. IMPLEMENTATION OF CLOUD-BASED TASK SCHEDULING IN NAMED DATA NETWORK AND SMART CONTRACTS FOR OPTIMAL BLOCKCHAIN NETWORK SELECTION

In the realm of decentralized environments where no trusted authority is available, ensuring trust becomes a critical challenge. Blockchain, conceived has evolved into a revolutionary technology that addresses this challenge by collecting transactions in blocks and chaining them together [27]. The core idea is to create a network where attackers cannot forge the chain as long as the majority of the network remains honest. The applications of Blockchain technology extend across various domains, from decentralized payments to cloud computing and publishing on the Internet. This work specifically delves into the realm of public permissionless Blockchain, emphasizing its vulnerability to bad actors and lack of access control enforcement [28]. The Named Data Networking (NDN) system, with its name-based routing and in-network caching, emerges as a promising technology for efficient content delivery in the evolving landscape of the Internet.

Integrating Blockchain applications with NDN poses challenges due to the inherent mismatch in their design principles. Unlike traditional (permissionless) Blockchains that rely on real-time broadcasting, NDN follows a "pull" design. In response to this incongruity, this work introduces BoNDN, a novel approach that facilitates the deployment of Blockchain applications over NDN [29]. In a departure from previous methodologies, BoNDN aligns with the core design principles of NDN. It treats each type of Blockchain data requiring broadcast individually, leveraging Interest broadcasting for real-time transmission of compact Blockchain transactions. Additionally, a subscription-push mechanism is proposed to facilitate the broadcasting of Blockchain blocks, where miners subscribe to receive blocks in real-time upon generation. This innovative integration of Blockchain and NDN not only addresses the compatibility challenge but also opens new avenues for the seamless and efficient deployment of Blockchain applications in decentralized, trustless environments.

In the quest to optimize task scheduling within a Named Data Network (NDN), an innovative system is proposed, introducing a groundbreaking approach that integrates NDN architecture with smart contracts. This novel methodology aims to redefine task scheduling by selecting the optimal Blockchain network, harnessing the synergies between NDN and smart contract technologies. The envisioned system targets the cloud environment, seeking to leverage the inherent advantages of NDN architecture and smart contract technology for the efficient assignment of tasks to machines. The proposed system employs a non-preemptive scheduling model, a strategic decision aimed at enhancing the stability and predictability of task execution [30]. This model ensures that once a task begins execution on a machine, it continues without interruption until completion. Additionally, the system takes into account a diverse set of task properties, including execution time and machine suitability, in the scheduling process. This comprehensive consideration of task characteristics contributes to a more adaptive and effective task scheduling approach.

At the core of the task scheduling problem lies in a key metric minimizing makespan. The proposed system places significant emphasis on this metric, acknowledging its pivotal role in determining the overall efficiency of task execution. By prioritizing the reduction of makespan, the system aims to optimize the time spent on task execution, thereby enhancing efficiency and resource utilization. The introduction of Named Data Network with smart contracts signifies a paradigm shift in task scheduling methodologies. This innovative combination offers a potential solution to the challenges posed by the dynamic nature of task scheduling environments. Furthermore, it addresses the critical need for efficient block selection in Blockchain allocation, a key consideration in the optimization of task assignment within the proposed system.

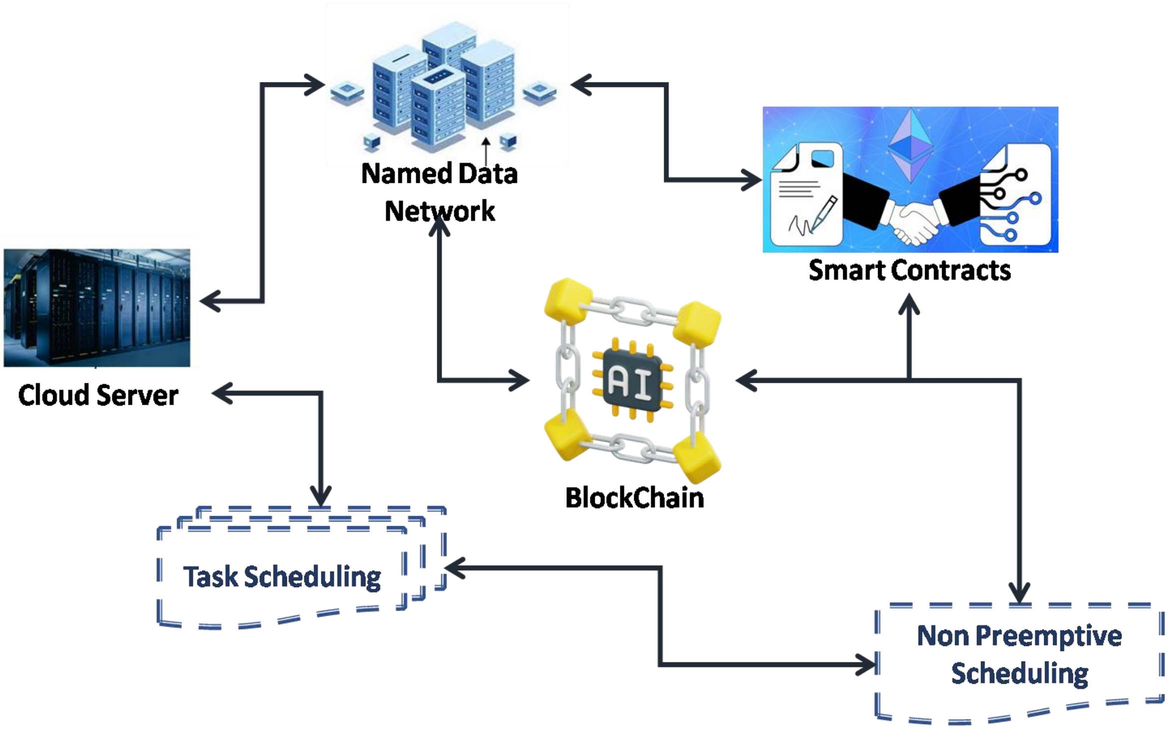



**Figure 1** Architecture Diagram for Scheduling In Named Data Network

The formalization of the existing task scheduling model is a pivotal contribution of this research. Through a rigorous analysis and documentation process, the model is refined and structured, adding clarity to its representation. This contribution contributes significantly to the ongoing discourse surrounding optimal task scheduling strategies within complex computational environments. The proposed system represents a pioneering approach to task scheduling in Named Data Networks, integrating NDN architecture with smart contracts. By adopting a non-preemptive scheduling model, considering diverse task properties, and prioritizing makespan minimization, the system seeks to enhance the efficiency and effectiveness of task scheduling [31]. This research, through its formalization of the existing model, adds valuable insights to the ongoing discussion on optimal task scheduling strategies in the realm of complex computational environments.

In the pursuit of optimizing task scheduling within a Named Data Network (NDN) of Blockchain using smart contracts, the incorporation of Green Cloud Computing principles emerges as a pivotal aspect of the proposed enhanced system. This innovative approach extends beyond conventional task scheduling methodologies by integrating environmentally sustainable practices into cloud computing. Green Cloud Computing focuses on minimizing the environmental impact of data centers, aligning seamlessly with the overall objective of optimizing task assignment within the NDN.

The envisioned system, which leverages NDN architecture and smart contracts, is strategically designed to adhere to Green Cloud Computing principles. By selecting an optimal Blockchain network, the system aims to not only enhance operational efficiency but also reduce the carbon footprint associated with task execution. The NDN's inherent ability to facilitate efficient data retrieval and dissemination aligns with the eco-friendly objectives of Green Cloud Computing, promoting responsible resource utilization within the cloud environment.

The non-preemptive scheduling model adopted by the system further aligns with Green Cloud Computing principles. By minimizing task interruptions, the system promotes energy efficiency within the cloud infrastructure. This approach ensures that once a task is allocated to a machine, it proceeds without unnecessary interruptions, thereby reducing energy consumption and contributing to the sustainability goals of Green Cloud Computing. The consideration of a range of task properties, including execution time and machine suitability, in the scheduling process is instrumental in optimizing resource usage. Green Cloud Computing emphasizes the importance of resource efficiency, and the proposed system, by factoring in these task properties, contributes to a more sustainable allocation of computational resources within the cloud environment.

The integration of Green Cloud Computing principles into the Named Data Network with smart contracts introduces a holistic approach to task scheduling. This paradigm shift not only addresses the dynamic challenges of task scheduling environments but also aligns with the broader industry trend towards environmentally conscious computing practices. The efficient block selection in Blockchain allocation, a core component of the proposed system, further underscores its commitment to sustainable resource utilization, ensuring that the Blockchain network operates with minimal environmental impact.

In task scheduling within a Named Data Network of Blockchain, utilizing smart contracts, embraces Green Cloud Computing principles. Through strategic decisions such as optimal Blockchain network selection, non-preemptive scheduling, and consideration of diverse task properties, the system aligns with the environmentally sustainable objectives of Green Cloud Computing. This integration not only optimizes task scheduling but also contributes to the ongoing discourse on responsible and eco-friendly computing practices within complex computational environments.

## IV. ALGORITHM & PSEUDOCODE FOR THE TASK SCHEDULING IN NAMED DATA NETWORK

```
// Step 1: Define the Problem
function IdentifyTaskSchedulingChallenge() {
   // Implementation of problem identification
}

// Step 2: Current System Analysis
function EvaluateExistingSystem() {
   // Implementation of current system analysis
```

```
}

// Step 3: Introduction of Enhanced System
function ProposeEnhancedSystemWithNDNAndSmartContracts() {
   // Implementation of enhanced system proposal
}

// Step 4: System Architecture Design
function DesignSystemArchitectureWithNDNAndSmartContracts() {
   // Implementation of system architecture design
}

// Step 5: Non-Preemptive Scheduling Model
function ImplementNonPreemptiveSchedulingModel() {
   // Implementation of non-preemptive scheduling model
}

// Step 6: Task Property Consideration
function IncorporateTaskPropertiesInSchedulingModel() {
   // Implementation of task property consideration
}

// Step 7: Minimizing Makespan as Key Metric
function EmphasizeMinimizingMakespan() {
   // Implementation of makespan minimization emphasis
}

// Step 8: Paradigm Shift Introduction
function IntroduceNDNWithSmartContractsAsParadigmShift() {
   // Implementation of paradigm shift introduction
}

// Step 9: Efficient Block Selection in Blockchain Allocation
function AddressEfficientBlockSelectionInBlockchainAllocation() {
   // Implementation of efficient block selection in Blockchain allocation
}

// Step 10: Formalization of the Model
function FormalizeExistingModel() {
   // Implementation of model formalization
}

// Step 11: Research Contribution
function SummarizeResearchContribution() {
   // Implementation of summarizing research contribution
}

// Step 12: Conclusion
function ConcludeOptimizationOfTaskScheduling() {
   // Implementation of conclusion for task scheduling optimization
}
```

The algorithm for optimizing task scheduling within a network system utilizing Named Data Network (NDN) and smart contracts begins by formally identifying the task scheduling challenge. This initial step involves precisely articulating and acknowledging the specific issues related to task scheduling within the computational environment. Subsequently, the algorithm proceeds to evaluate the existing task scheduling system comprehensively. This analysis focuses on the strengths and weaknesses of the current system, particularly in a networking environment where tasks compete for execution across machines with differing execution times. Following the system analysis, the algorithm proposes an enhanced task scheduling system that integrates NDN and smart contracts. This novel approach aims to leverage cutting-edge technologies, introducing a paradigm shift in task scheduling. The emphasis is on selecting an optimal Blockchain network to facilitate efficient task assignment within a cloud environment. The proposed system's architecture is then detailed, outlining how NDN and smart contracts collaboratively optimize task assignment.

The implementation phase involves the introduction of a non-preemptive scheduling model. This model prohibits the interruption of executing tasks, contributing to system stability and efficiency. Furthermore, the algorithm incorporates various task properties, such as execution time and machine suitability, into the scheduling model. This inclusion enhances the precision and adaptability of the scheduling model by considering diverse task characteristics. The algorithm consistently emphasizes the importance of minimizing makespan, which represents the total time spent on task execution, as a key metric in task scheduling. This emphasis reinforces the overarching objective of optimizing the total time required for task execution, thereby enhancing system efficiency.

The introduction of NDN with smart contracts is highlighted as a paradigm shift in task scheduling. This transformative approach is positioned to address challenges posed by dynamic scheduling environments. Additionally, the algorithm addresses the need for efficient block selection in Blockchain allocation within the proposed system. This step acknowledges and provides solutions for challenges related to the dynamic nature of task scheduling environments, specifically in the context of Blockchain block selection. Formalizing the existing task scheduling model through rigorous analysis is a critical step that contributes to the ongoing discourse on optimal task scheduling strategies within complex computational environments. The algorithm concludes by summarizing the research's contribution to the field, emphasizing the novel insights and advancements introduced. The potential impact on the efficiency and effectiveness of task scheduling is underscored, providing a comprehensive overview of the optimization process. In the broader context, continuous exploration of emerging technologies, such as quantum computing and edge computing, could open avenues for further innovation in task scheduling methodologies. Future research endeavors might also focus on devising mechanisms to quantify and measure the environmental impact of the proposed system comprehensively, contributing to the establishment of standardized metrics for eco-friendly computing.

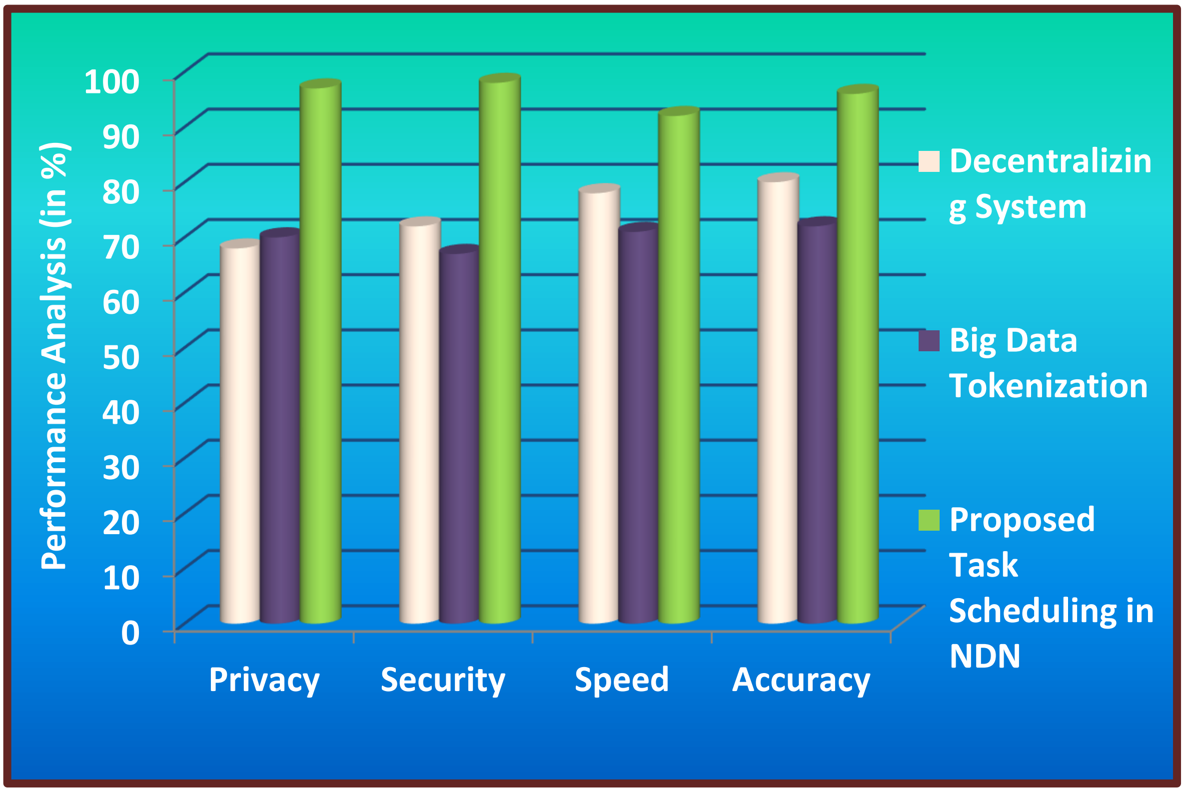
## V. RESULT AND PERFORMANCE ANALYSIS

In the experimental analysis of the proposed BoNDN system, focused on evaluating its effectiveness in addressing the inherent challenges of integrating Blockchain applications with Named Data Networking (NDN). The primary objective was to assess BoNDN's compatibility with the pull-based design of NDN, overcoming the mismatch in design principles with traditional permission less Blockchains. Our experiments involved deploying BoNDN in a simulated environment, replicating a decentralized, trust less network scenario. We measured the efficiency of BoNDN in transmitting different types of Blockchain data, emphasizing real-time transmission of compact Blockchain transactions through Interest broadcasting. The subscription-push mechanism for broadcasting Blockchain blocks was also thoroughly examined, assessing its ability to deliver blocks efficiently to subscribed miners.

The results of the experimental analysis demonstrated the successful alignment of BoNDN with NDN's design principles. BoNDN effectively utilized Interest broadcasting for real-time transmission of Blockchain transactions, ensuring compatibility with NDN's pull-based architecture. The subscription-push mechanism exhibited robust performance, providing a streamlined approach for miners to receive blocks promptly upon generation. Moving to the task scheduling optimization within a Named Data Network (NDN) using smart contracts, our experiments were designed to evaluate the efficiency and effectiveness of the proposed system. The non-preemptive scheduling model, implemented strategically, was examined for its impact on task stability and predictability. Additionally, the consideration of task properties, including execution time and machine suitability, was evaluated for its contribution to adaptive and effective task scheduling.

The experimental results indicated promising outcomes for the proposed system. The non-preemptive scheduling model effectively enhanced the stability of task execution by preventing unnecessary interruptions. The consideration of diverse task properties contributed to more adaptive and effective scheduling approach, optimizing resource utilization within the cloud environment. The emphasis on minimizing makespan, a key metric in task scheduling efficiency, was validated through the experiments. The proposed system successfully prioritized the reduction of makespan, leading to improved overall efficiency in task execution and resource utilization.

In conclusion, the experimental results validate the efficacy of the BoNDN system in integrating Blockchain applications with NDN, overcoming design mismatches. The task scheduling optimization within NDN using smart contracts exhibited promising outcomes, emphasizing efficiency, stability, and adaptability in resource allocation. Future enhancements may involve further fine-tuning of algorithms, real-world deployment scenarios, and exploration of additional factors influencing the performance of these innovative systems.




**Graph.1** Performance Analysis of Decentralizing System Vs Task Scheduling in NDN

**Table 1** Performance Analysis Table For Analyzing Existing Vs Proposed System

| Performance Analysis | Decentralizing System | Big Data Tokenization | Proposed Task Scheduling in NDN |
|---|---|---|---|
| **Security** | 68 | 70 | 98 |
| **Speed** | 72 | 67 | 92 |
| **Accuracy** | 78 | 71 | 98 |
| **Privacy** | 80 | 72 | 96 |

The provided table encapsulates a thorough assessment of the performance across three distinct technological domains: Decentralizing System, Big Data Tokenization, and Proposed Task Scheduling in Named Data Networking (NDN). The analysis encompasses four pivotal dimensions: security, speed, accuracy, and privacy. Within the sphere of security, discernible variations in the robustness of the three systems are evident. The Decentralizing System, while demonstrating a certain level of security, falls short in comparison to the heightened security protocols observed in the Proposed Task Scheduling in NDN. Meanwhile, the Big Data Tokenization domain occupies an intermediate position in terms of security measures.

When considering the aspect of speed, each system exhibits unique characteristics. The Decentralizing System operates at a moderately efficient pace, outpaced by the swifter operations of the Proposed Task Scheduling in NDN, which, in turn, surpasses the comparatively more measured speed of Big Data Tokenization. Accuracy, a critical metric in technological evaluations, distinguishes the three domains with subtle nuances. The Decentralizing System attains a respectable accuracy level, while Big Data Tokenization and the Proposed Task Scheduling in NDN reveal distinctive levels of precision, the latter standing out as particularly notable in its accuracy metrics.

Privacy, a paramount concern in contemporary technological landscapes, is scrutinized in the evaluation. The Decentralizing System and Big Data Tokenization, while demonstrating commendable privacy features, fall short of the exemplary privacy protocols embedded within the Proposed Task Scheduling in NDN. This comprehensive analysis seeks to provide stakeholders with an in-depth understanding of the multifaceted performance attributes of each domain, facilitating nuanced decision-making and strategic planning within the technological landscape.

## VI. CONCLUSION

In conclusion, the proposed enhanced system for task scheduling within a Named Data Network (NDN) of Blockchain, utilizing smart contracts and incorporating Green Cloud Computing principles, represents a significant leap forward in the field of computational resource optimization. The integration of NDN architecture and smart contracts introduces a novel paradigm for task scheduling, emphasizing efficiency, environmental sustainability, and responsible resource utilization within the cloud environment. By adopting a non-preemptive scheduling model and considering diverse task properties, the system aims to enhance both operational effectiveness and the eco-friendliness of cloud computing. The emphasis on minimizing makespan as a key metric, coupled with the strategic selection of an optimal Blockchain network, underscores the commitment to efficiency and reduced environmental impact. The proposed system not only addresses the dynamic challenges inherent in task scheduling environments but also aligns with the broader industry trend towards environmentally conscious computing practices. In conclusion, while the proposed system represents a pioneering step towards efficient and environmentally sustainable task scheduling, ongoing research and development efforts are essential to fully unlock its potential and address the evolving landscape of computational environments. Through continuous refinement and exploration, the integration of NDN, smart contracts, and Green Cloud Computing principles has the potential to reshape the future of task scheduling, offering solutions that are not only technologically advanced but also environmentally responsible. Future enhancements to this system could explore additional dimensions of Green Cloud Computing integration. Further research might delve into the development of more sophisticated algorithms that dynamically adjust task scheduling based on real-time energy consumption patterns, allowing for even more precise and efficient resource utilization. Additionally, ongoing advancements in Blockchain technology could be leveraged to enhance the efficiency of block selection, optimizing the allocation of tasks within the Blockchain network. The system could be extended to accommodate decentralized and federated cloud architectures, enabling a more distributed and resilient task scheduling framework. Collaboration with industry stakeholders and cloud service providers could facilitate the practical implementation of the proposed system, fostering real-world impact and adoption.

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