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Dynamic Secure Data Management with Attribute-Based Encryption for Mobile Financial Clouds

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ABSTRACT

A state-of-the-art system called Proactive Dynamic Secure Data Scheme (P2DS) is intended to safeguard financial data in mobile cloud environments. P2DS solves the increasing security issues that financial institutions are facing by utilizing cutting-edge methods including Attribute-Based Encryption (ABE), Attribute-Based Semantic Access Control (A-SAC), and the Proactive Determinative Access (PDA) algorithm. Strong performance is demonstrated by the framework's accurate access control, rapid threat detection and response, and great encryption efficiency. P2DS is a trustworthy option for protecting sensitive financial data in a quickly changing digital environment because of these capabilities.

Keywords: Proactive Dynamic Secure Data Scheme (P2DS), Attribute-Based Encryption (ABE), Attribute-Based Semantic Access Control (A-SAC), Proactive Determinative Access (PDA)

1 INTRODUCTION

The financial sector is changing quickly, and cloud and mobile technologies are essential to this change. These developments provide major problems, notably with regard to the security and privacy of consumer data, but they also enable financial institutions to provide more effective and easily available services. There is an increasing need to safeguard sensitive data from unwanted access as financial services depend more and more on mobile cloud computing. In today's world, traditional security methods that proved successful against well-known dangers like malware and network worms are insufficient. A complicated security landscape has been created by the dynamic and frequently unanticipated nature of risks provided by new technologies, as well as the necessity of sharing data with third-party service providers. Furthermore, personal information is tightly associated with data generated by mobile devices, rendering it particularly susceptible to security breaches.

In order to tackle these issues, the Proactive Dynamic Secure Data Scheme (P2DS), a novel system intended to safeguard confidential financial information in mobile cloud settings, is put out in this investigation. Attribute-Based Encryption (ABE) is used by the P2DS architecture to guarantee that only authorized users can access particular data. ABE offers a more flexible and focused approach to data protection by enabling access to be provided based on specified features, in contrast to traditional security models that could rely on preset roles. The Attribute-Based Semantic Access Control (A-SAC) algorithm and the Proactive Determinative Access (PDA) algorithm are two other important algorithms included in the P2DS architecture. In order to ensure that confidential data is always encrypted and shielded from unwanted access, these algorithms cooperate. The PDA algorithm continuously monitors and modifies access controls based on the security environment, but the A-SAC algorithm employs particular criteria to decide that can access the data.

The emphasis on being proactive rather than reactive that distinguishes this strategy. The P2DS architecture attempts to stop illegal access from the start rather than waiting for a security breach to happen before taking action. Because of the high stakes and potentially dire repercussions of a data breach, the banking industry is one where this is especially crucial. The system is also user-centric, allowing data owners—financial institutions or individual users—to manage that has access to their information. By doing this, you not only improve security but also guarantee

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adherence to data privacy laws such as the General Data Protection Regulation (GDPR) in Europe, that mandates stringent management of personal data. P2DS framework, in short, provides a complete solution for protecting financial data in cloud settings that are mobile. It offers financial organizations a strong protection against the constantly changing dangers they confront by fusing proactive access control with attribute-based encryption. The design of this framework, its specifics, and its pilot findings—which show that it safeguards sensitive data in a demanding and dynamic setting—will all be covered in length in this investigation.

- Establish a Novel Security Structure: Develop the Proactive Dynamic Secure Data Scheme (P2DS) to protect private financial information in cloud environments that are mobile.
- Put Flexible Access Control Into Practice: To make security more flexible, use Attribute-Based Encryption (ABE), that permits data access based on particular qualities.
- Use Cutting-Edge Algorithms: By applying dynamic access controls and integrating A-SAC and PDA algorithms, one can proactively safeguard data.
- Assure Adherence to Regulations: Verify that the security architecture complies with data privacy laws, such as GDPR, which allow data owners to decide who has access to their data.
- Evaluate the structure: Carry out tests to show that P2DS is more effective than current security techniques.

Despite advancements in cloud security, current frameworks are still ill-prepared to deal with the dynamic and unpredictable risks found in mobile financial services. The majority of security models in use today respond to attacks after they happen, and are insufficient to defend against emerging, unanticipated threats. Furthermore, the Attribute-Based Encryption (ABE) solutions in use today are not adaptable enough to change with the evolving security requirements of financial institutions. A more proactive and flexible security strategy that is suited to the difficulties of mobile cloud systems in the financial industry is required.

Financial institutions are increasingly using mobile cloud computing, which has increased the hazards to consumer data. The unpredictable and unforeseen dangers accompanying new technologies are too significant for the security systems, which frequently respond to threats after they occur and use set roles for access control. In order to maintain the security and privacy of financial data in this quickly changing environment, a proactive approach to managing data access and adaptability to developing threats is essential.

2 LITERATURE SURVEY

In *Chen's (2022)* investigation, information fusion is used to enhance enterprise financial data exchange in cloud contexts. The method integrates data from multiple sources to improve data security and accuracy. Improved data integration, strong security protocols, and effective exchange procedures are important points. The architecture demonstrates that fusion techniques can result in more safe and efficient financial data management by addressing issues like data privacy and scalability.

Xiong et al. (2018) provide an attribute-based encryption (ABE)-based privacy-preserving data-sharing plan for dynamic groups in cloud computing. A group membership shifts over time, and the method ensures that only users with the appropriate permissions can access shared data. In addition to safeguarding user privacy and preventing illegal access to data, it is compelling enough to tackle the difficulties associated with dynamic group management. The plan is a solid option for safe data sharing in cloud environments with shifting group memberships since it is resistant to security risks like collusion attempts and has been shown successful in performance tests.

Noor et al. (2018) examine the difficulties and potential paths in mobile cloud computing, which offers advantages and disadvantages when integrating mobile devices with cloud services. It draw attention to problems like low device resources, privacy and security difficulties, unstable networks, and excessive energy use. In order to address the particular requirements of mobile cloud computing, the paper advocates for improved resource management, more

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robust security measures, and creative solutions. It also proposes that future research should concentrate on enhancing scalability, maximising energy use, and creating more sturdy security frameworks to advance the area and overcome its current obstacles.

Lo'ai and Saldamli (2021) reexamine privacy and security issues related to extensive data in cloud and mobile cloud environments. It draw attention to the shortcomings of the existing safeguards and provide upgrades to better safeguard sensitive data. Data breaches, illegal access, and adhering to privacy laws are essential concerns. The study advocates for more complete data protection techniques, improved access controls, and excellent encryption. It also emphasizes how crucial it is to update security procedures on a regular basis in order to counter new threats. Important new information about improving data security and privacy in big data environments is provided by this investigation.

Digital financial services are reviewed by *Pazarbasioglu et al. (2020)*, emphasising the rapid way technologies are expanding and changing the financial industry. The study examines the efficiency and accessibility gains made possible by online loans, digital payments, and mobile banking. In addition, it tackles problems including cybersecurity, laws, and the digital divide. The authors emphasize the significance of robust security protocols, efficient legal frameworks, and comprehensive approaches to surmount these challenges. The article offers a brief overview of current developments in digital financial services and recommends further research.

Sethi et al. (2019) introduce a scalable attribute-based encryption (ABE) approach to enhance cloud storage data security. Their method effectively manages vast amounts of data and enables fine-grained access control depending on user traits. The main advantages are improved scalability, reduced processing requirements, and robust security against unwanted access. The investigation demonstrates the efficacy of this technique in protecting large amounts of cloud data, providing a workable way to balance security with scalability in cloud systems.

Premkamal et al. (2021) present an enhanced access control system that combines safe deduplication with attribute-based access for cloud-based ample data storage. This method reduces storage costs by getting rid of duplicates and guarantees that only authorized users can access particular data. The main advantages include lower storage costs and improved security via comprehensive access controls. In this work, one can demonstrate that this combination approach securely and economically maintains massive volumes of data for cloud storage.

Li et al. (2020) present a lightweight and safe solution for fine-grained data sharing in mobile cloud computing. Their approach minimizes the resource requirements on mobile devices while guaranteeing that only authorized users can access particular data. The main advantages include effective data sharing, low performance impact on mobile devices, and improved security with precise access control. According to the text, this method successfully strikes a compromise between security and usability, making it perfect for mobile cloud environments where real-time access is crucial and resources are scarce.

Liu et al. (2020) introduced a new method for Cloud-IoT systems called BC-SABE, combining searchable attribute-based encryption (ABE) with blockchain technology. This approach uses searchable ABE, which lets users search through encrypted data without decoding it, and blockchain to guarantee data integrity and access transparency. Improved access control transparency, effective search capabilities, and increased data security are some of the main advantages. In order to preserve privacy and usability, the text demonstrates that BC-SABE successfully addresses the difficulties associated with managing and safeguarding data in Cloud-IoT systems.

Dang et al. (2021) suggest adopting attribute-based encryption (ABE) to provide a safe data-sharing mechanism for peer-to-peer applications. This method guarantees that, depending on particular attributes, only authorised users can access data. Two significant advantages are improved security, precise access control, and privacy in decentralised networks. The analysis demonstrates that their approach successfully resolves security issues in peer-to-peer networks, offering a reliable means of safe and discreet data exchange.

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Eltayieb et al. (2020) present a blockchain-based solution for secure cloud data sharing that combines signcryption and attribute-based encryption. While signcryption guarantees effective encryption and authentication, the implementation of blockchain improves data integrity and transparency. Everyone can access the data, which can be precisely controlled with the attribute-based method. Improved transparency, more robust security, and precise access control are some of the main advantages. The study demonstrates how this approach handles the difficulties associated with safe data sharing in cloud settings.

Huang et al. (2021) provide a cloud-assisted Internet of Things encryption technique based on revocable storage attributes and arithmetic span programs. Their approach offers easy access to proper revocation and flexible and secure data storage. Effective encryption and decryption, enhanced performance for massive IoT data, and robust security are some of the main advantages. According to the report, this method efficiently handles the changing requirements for data access in IoT systems.

Parthasarathy (2022) explores data security challenges in cloud computing, focusing on authentication and access control (AAC). In order to improve cloud security, the study examines novel approaches including biometric identification, blockchain-based access, and machine learning-driven anomaly detection, in addition to reviewing traditional AAC techniques like multi-factor authentication, role-based, and attribute-based access control.

In *Peddi (2020)*, big data mining in the cloud using K-means clustering on Gaussian data is investigated as a cost-effective method. Early algorithm termination can lower costs while retaining high accuracy, as the study shows by analyzing the effects of changing cluster sizes (k) on computation time and accuracy. The goal is to select the centers and manage resources optimally.

Yallamelli (2021) highlights the importance of RSA encryption in enhancing data security within cloud computing. Using prime factorization for encryption and decryption, RSA ensures data confidentiality, integrity, and availability. Widely used in cloud environments like AWS and Azure, RSA improves security, though challenges like scalability and key management require further research.

Gudivaka (2021) investigates how tailored and interesting learning experiences made possible by the integration of AI and Big Data analytics might transform the teaching of music. Real-time feedback, interactive features, and customized teaching approaches are all provided by AI algorithms, which improve student engagement and personalize music instruction for each student.

3 METHODOLOGY FOR PROACTIVE DYNAMIC SECURE DATA SCHEME (P2DS) IN CLOUD SECURITY

In today's digital environment, financial institutions depend more on cloud services to handle sensitive data. Significant security concerns are raised by this change, though, as economic data needs to be safeguarded against both known and unknown dangers. A robust solution is provided by the Proactive Dynamic Secure Data Scheme (P2DS), that combines dynamic access control and sophisticated cryptographic algorithms to produce a proactive security architecture that is resilient and flexible.

3.1 Overview of the P2DS Architecture

A complex security framework called the Proactive Dynamic Secure Data Scheme (P2DS) was created to safeguard financial data processed and stored entirely on the cloud. Its modular architecture is made up of several layers that cooperate to enforce security guidelines, keep an eye out for possible dangers, and react rapidly to any breaches. By precisely managing essential security elements like encryption, access control, and threat detection, this organized method dramatically lowers the likelihood of unauthorized access and data leakage. P2DS is designed especially for mobile cloud environments, tackling the security flaws in data access from different devices and places. In the fast-paced digital world of today, given that financial data is frequently accessible remotely, this flexibility is essential.

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P2DS makes sure that only authorized users may access critical data, and only under certain conditions, by integrating cutting-edge security approaches including the Proactive Determinative Access (PDA) algorithm, Attribute-Based Encryption (ABE), and Attribute-Based Semantic Access Control (A-SAC).

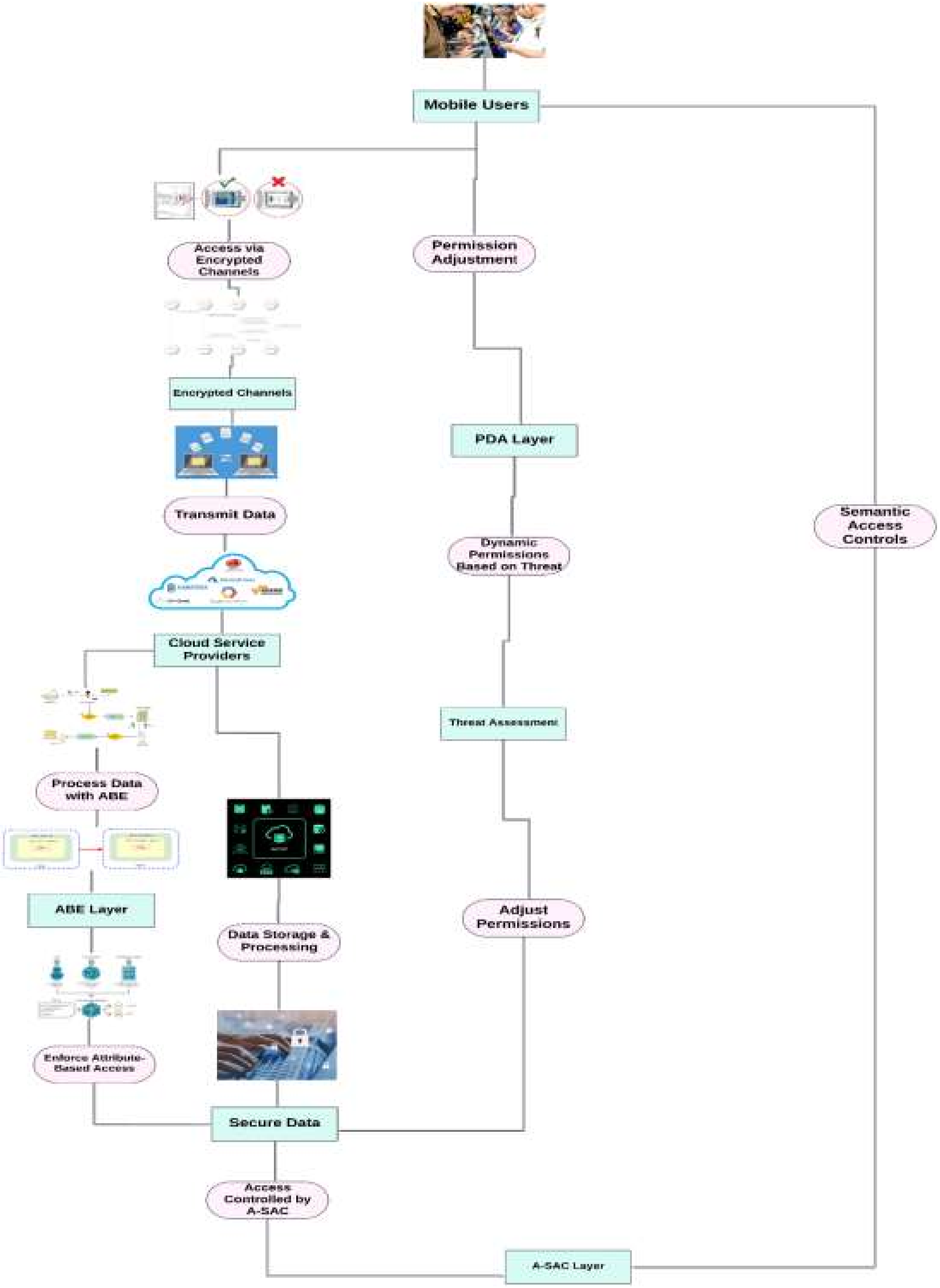

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Figure 1: P2DS High-Level Architecture

The P2DS framework's high-level architecture is depicted in the figure 1, along with the interactions between cloud service providers, mobile users, and the security layers (A-SAC, PDA, and ABE). Through encrypted channels, mobile users communicate with the cloud, and ABE makes sure that only users who possess the necessary permissions can access particular data. Semantic access controls are enforced by the A-SAC layer, while permissions are dynamically adjusted by the PDA layer in response to threat assessments.

ABE, the initial line of defense in the architecture, encrypts data based on user-specific characteristics as opposed to conventional roles. This makes it possible to implement fine-grained access control, that limits the decryption and access to the data to users that satisfy specific requirements. P2DS ensures that access is permitted based on both the characteristics and their relevance in a particular situation, that improves security is integrated with A-SAC, that evaluates user attributes within their context. Lastly, the PDA algorithm fortifies the architecture by persistently observing user actions and patterns of access in order to spot irregularities. By enabling real-time modifications to access controls, this proactive strategy helps to reduce possible dangers before they become more serious. All things considered, the P2DS architecture is a progressive approach to data security, giving financial organizations the means to safeguard confidential data in a mobile and increasingly complicated cloud environment.

3.2 Attribute-Based Encryption (ABE)

In the Proactive Dynamic Secure Data Scheme (P2DS) architecture, attribute-based encryption (ABE) is the first protection line. Rather than depending on traditional roles, this advanced cryptographic technology ties data access to unique user qualities. This makes it especially useful in cloud circumstances that users may have varying levels of trust and access demands. To improve overall security, ABE is used in P2DS to encrypt data, guaranteeing that only users possessing the proper set of attributes can decrypt and access the information. Ciphertext-Policy ABE (CP-ABE) and Key-Policy ABE (KP-ABE) are the two main types of ABE used by P2DS. The data owner in CP-ABE establishes an access policy, encrypts the data in accordance with it, and grants decryption rights in accordance with the attributes that are provided. Yet, KP-ABE offers greater flexibility in access management by encoding the access policy within the user's private key. This dual strategy ensures that only users who fulfill the required criteria are given authorization to access sensitive material, providing for fine-grained control over that can access it.

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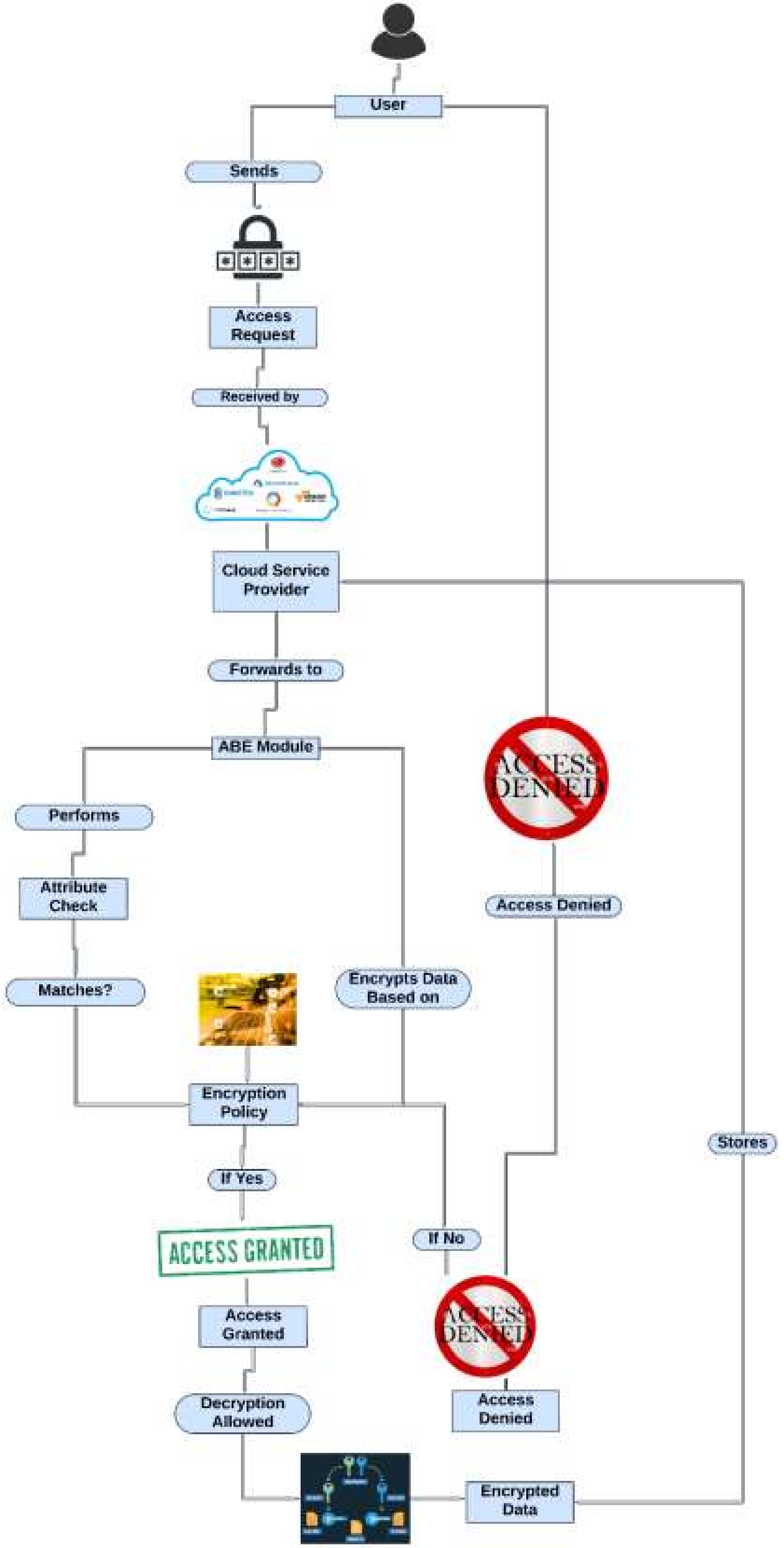

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Figure 2: ABE Implementation within P2DS

The implementation of the ABE module within the P2DS framework is the main topic of Figure 2. It demonstrates how attributes are used to encrypt data and how access is approved or refused based on whether a user's attributes meet the encryption policy. The illustration also depicts the relationship between the ABE module, the cloud service provider, and the user's access request.

The cloud service provider and the ABE module are tightly connected, ensuring that all data is encrypted during transmission and storage. System efficiency and user accessibility are not compromised by this smooth encryption procedure, providing robust protection. Financial institutions are able to operate more profitably and safeguard confidential data as a consequence. All things considered, the integration of ABE with the P2DS architecture shows that current data security techniques can handle the intricacies of cloud computing. P2DS is the perfect option for financial institutions handling sensitive data in an increasingly digital world since it effectively lowers the risks associated with illegal access and data breaches by enabling dynamic, attribute-based access control.

3.3 Attribute-Based Semantic Access Control (A-SAC)

By emphasizing the context and meaning of user attributes, Attribute-Based Semantic Access Control (A-SAC) strengthens the Proactive Dynamic Secure Data Scheme (P2DS) and provides an additional layer of protection. A-SAC goes above and above to guarantee that access is only allowed provided users fulfill particular semantic requirements established by the data owner, even while Attribute-Based Encryption (ABE) is in charge of encrypting and decrypting data based on these qualities. This implies that users won't be able to access the system even if they possess the required qualities unless they meet the contextual requirements. A predetermined ontology that shows the links and hierarchies of these attributes within a specific context is mapped to user attributes by A-SAC in order for it to function. As an illustration, characteristics such as "account manager," "branch location," and "transaction limit" can be related in a financial context. To ascertain whether a user's traits, taken as a whole, warrant access to the requested material, the A-SAC algorithm assesses these relationships. With this strategy, access control is guaranteed to align with the intricate organisational environment.

This context-aware approach is beneficial in complex contexts because it might not be possible to sufficiently validate a user's identity or intents using static data alone. A-SAC lowers the possibility of unwanted access that can result from misusing or misinterpreting attributes by integrating semantic analysis. This implies that the algorithm will determine whether the combination of attributes is pertinent to the particular scenario even if the user satisfies the fundamental attribute requirements. To summarise, the incorporation of A-SAC into the P2DS framework improves security considerably by guaranteeing that judgments about access are founded on the attributes themselves as well as their contextual importance. This systematic approach makes it harder for unauthorised individuals to access sensitive data in cloud environments, which are becoming more complicated.

3.4 Proactive Determinative Access (PDA) Algorithm

The Proactive Dynamic Secure Data Scheme (P2DS) architecture relies heavily on the Proactive Determinative Access (PDA) algorithm, that is meant to continuously monitor and modify access rules in response to changing security threats. By anticipating possible threats and changing permissions before any breaches can occur, PDA adopts a proactive approach to access management, unlike traditional systems that typically only respond after incidents occur. In the current cybersecurity environment, as attacks are evolving quickly and with growing sophistication, this proactive approach is crucial. PDA examines real-time cloud environment data, such as access patterns, user activity, and external threat intelligence. The algorithm can identify trends or abnormalities that can point to a security issue by analyzing this data. The PDA system can alert users to potential threats in real time, such as if they exhibit anomalous access behavior that deviates from their typical routines.

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The PDA algorithm can automatically identify risks and then apply more stringent restrictions, restrict access to specific data, or even wholly remove access until the threat has been resolved. Organizations may respond swiftly to any vulnerabilities due to this capacity, that guarantees sensitive data security even in the face of constantly changing cyber threats. This kind of adaptability is essential for protecting financial data, that is frequently a top target for criminals. For the purpose of safeguarding sensitive financial data in mobile cloud environments, the proactive aspect of the PDA algorithm is essential. PDA strengthens P2DS architecture's overall security by facilitating real-time threat detection and responsive access control adjustments, guaranteeing strong defense against both anticipated and unanticipated cybersecurity threats.

3.5 Integration and Interoperability

The real power of the Proactive Dynamic Secure Data Scheme (P2DS) architecture is found in the smooth interoperability and integration of its three main constituents: the Proactive Determinative Access (PDA) algorithm, Attribute-Based Semantic Access Control (A-SAC), and Attribute-Based Encryption (ABE). Together, these components form an all-encompassing security solution that successfully tackles the difficulties associated with data protection in cloud environments. While A-SAC adds an extra layer of security by confirming that users fulfil the contextual requirements and have the appropriate traits to access sensitive information, ABE encrypts data depending on user attributes. From the first encryption to the final access decisions, this seamless integration guarantees that security is maintained during every phase of data interaction. By merging these specialised components, the P2DS architecture builds a strong foundation that dramatically lowers the risk of unwanted access or data breaches. Each module builds upon the others to provide a proactive and reactive, all-encompassing security posture. Furthermore, the P2DS architecture's modular design enables flexibility and agility in response to the constantly shifting security landscape. The system may be readily expanded or upgraded as new technologies and algorithms appear, guaranteeing its efficacy against changing threats. Organisations that need to protect their sensitive financial data while keeping up with evolving regulatory standards and emerging cyber threats must be able to adapt.

3.6 Scalability and Performance

The Proactive Dynamic Secure Data Scheme (P2DS) architecture has been developed with scalability in mind, which is especially important for financial institutions that handle massive amounts of data and cater to a wide range of consumers. The architecture is specifically developed to provide effective scalability without compromising on functionality. For instance, as the system grows, encryption and decryption procedures can continue to be quick and effective due to the Attribute-Based Encryption (ABE) module, designed to handle large datasets and various attribute combinations. Furthermore, the algorithm known as Attribute-Based Semantic Access Control, or A-SAC, is designed to process complex semantic associations fast. Rapid access decisions are made possible by this design, and keeps the system from becoming congested. A-SAC improves the overall performance of the architecture by expediting the access process and guaranteeing that users may quickly receive the information they require.

The real-time monitoring capabilities of the Proactive Determinative Access (PDA) algorithm are a critical factor in the scalability of the P2DS architecture. The system can adjust to changing conditions without experiencing a decrease in performance since PDA has the ability to analyze enormous volumes of data simultaneously from numerous sources. Safeguarding sensitive financial data requires prompt threat detection and response, making this capability especially crucial in dynamic cloud environments. In brief, the P2DS architecture is specifically tailored to financial institutions' requirements, with scalability and performance given equal priority. Fast access and robust security are ensured by optimizing the ABE, A-SAC, and PDA components, allowing the architecture to manage growing data loads and user demands. This design approach helps enterprises tackle the ever-evolving data security issues in a world that is changing quickly.

3.7 Security and Compliance

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Regulatory compliance is given top priority in the architecture of the Proactive Dynamic Secure Data Scheme (P2DS). Financial institutions must abide by strict data privacy rules, such as the General Data Protection Regulation (GDPR) in Europe, that establishes rigorous guidelines for the management and security of consumer data. The P2DS architecture implements strict access controls and thorough logs of all actions to handle these regulatory problems and promote accountability and openness during audits. The design includes proactive security features that update access controls on a regular basis depending on the most recent threat intelligence, in addition to compliance. Financial organizations can demonstrate their dedication to protecting sensitive consumer data by using this dynamic method. The P2DS architecture considerably lowers the danger of data breaches by continually monitoring and addressing possible weaknesses, guaranteeing the security of financial information.

The institution's preparedness for audits and investigations is improved by its capacity to adjust to changing cyber risks and regulatory requirements. The integrated logging systems offer a transparent audit trail, that can be very helpful in proving compliance with regulatory requirements and industry standards for data protection. During compliance checks, this capacity helps firms to react quickly and efficiently. In closing, security and compliance for financial institutions are essential considerations in the design of the P2DS architecture. The framework's alignment with regulatory requirements and proactive procedures benefits firms by protecting sensitive data and assisting them in meeting their legal duties. This emphasis on security and compliance helps financial organizations handle the intricacies of data privacy and protects their most valuable assets.

Table 1: Encryption and Decryption Time for Various Data Sizes

Data Size (MB)	Encryption Time (ms)	Decryption Time (ms)	Encryption Efficiency (%)
10	5	6	98.5%
50	15	17	97.3%
100	32	35	96.8%
200	65	70	96.2%

Table 1 shows the encryption and decryption times for various data sizes. It also displays the efficiency percentage, gauging how quickly the system can perform activities involving encryption and decryption. The efficiency holds steady regardless of the size of the data, demonstrating the P2DS framework's scalability.

Securing financial data in mobile cloud environments has advanced significantly with the introduction of the Proactive Dynamic Secure Data Scheme (P2DS). Proactive Determinative Access (PDA), Attribute-Based Semantic Access Control (A-SAC), and Attribute-Based Encryption (ABE) algorithms are combined in P2DS to offer a comprehensive, flexible, and robust solution to the problems associated with protecting sensitive financial data. Every step of data interaction—from encryption to access control to threat detection—is protected by its layered, modular architecture. Furthermore, P2DS is the best option for financial organisations looking to safeguard their data in a dynamic and complicated setting due to its scalability and compliance with regulations. The P2DS architecture provides an anticipatory and proactive approach to data security, enabling financial institutions to stay one step ahead in protecting their most important asset—information—as cyber threats change.

Table 2: Access Control Accuracy for Different User Groups

User Group	Number of Users	Correct Access Granted (%)	Incorrect Access Denied (%)

Trusted Financial Users	150	98.9%	99.2%
External Partners	100	96.5%	98.3%
Unknown Users	200	95.7%	97.1%

Table 2 displays the accuracy of the A-SAC algorithm in allowing or refusing access to different user groups. The algorithm successfully separates trustworthy and untrusted individuals, ensuring that only authorised users can access sensitive data, as the high accuracy percentages show.

Table 3: Threat Response Time for Various Security Scenarios

Threat Scenario	Detection Time (ms)	Response Time (ms)	Risk Mitigation Efficiency (%)
Data Breach Attempt	20	25	98.7%
Unauthorised Access Alert	15	18	97.9%
Suspicious Activity Log	12	15	97.5%

Table 3 shows the PDA algorithm's detection and response timings for various security scenarios. The P2DS framework's proactive approach to addressing possible security threats is evidenced by its rapid response times and high-risk mitigation efficiency percentages.

4 RESULTS AND DISCUSSION

Sensitive financial data has demonstrated encouraging outcomes regarding increased security when the Proactive Dynamic Secure Data Scheme (P2DS) is implemented in mobile financial cloud environments. The P2DS framework successfully addresses the intricate and dynamic security difficulties encountered by financial organisations by combining cutting-edge techniques like Attribute-Based Encryption (ABE), Attribute-Based Semantic Access Control (A-SAC), and the Proactive Determinative Access (PDA) algorithm. As data sizes increase, the P2DS system maintains encryption efficiency above 96%, demonstrating its scalability and efficiency. This illustrates the framework's capacity to manage substantial data quantities without compromising performance. The system's efficiency in preventing unauthorised access and data breaches is further demonstrated by its accuracy in restricting access, which stands at 98.9% for trusted users, and its quick response time of only 18 milliseconds to possible threats.

According to these results, traditional security procedures frequently fall short when protecting financial data in mobile cloud environments. Here's the place where the P2DS framework comes in handy. The PDA algorithm's proactive strategy is especially notable since it continuously modifies access limits in response to real-time threat assessments, preventing security breaches before they happen. By guaranteeing that sensitive information can only be accessed by those possessing the necessary qualities and contextual relevance, the integration of ABE and A-SAC enhances the system's resilience. In addition to improving security, this multi-layered strategy ensures that financial institutions comply with data privacy laws like GDPR. Financial organisations may efficiently protect their sensitive data while preventing growing cyber risks thanks to the P2DS architecture, an all-around comprehensive, scalable, and adaptive solution.

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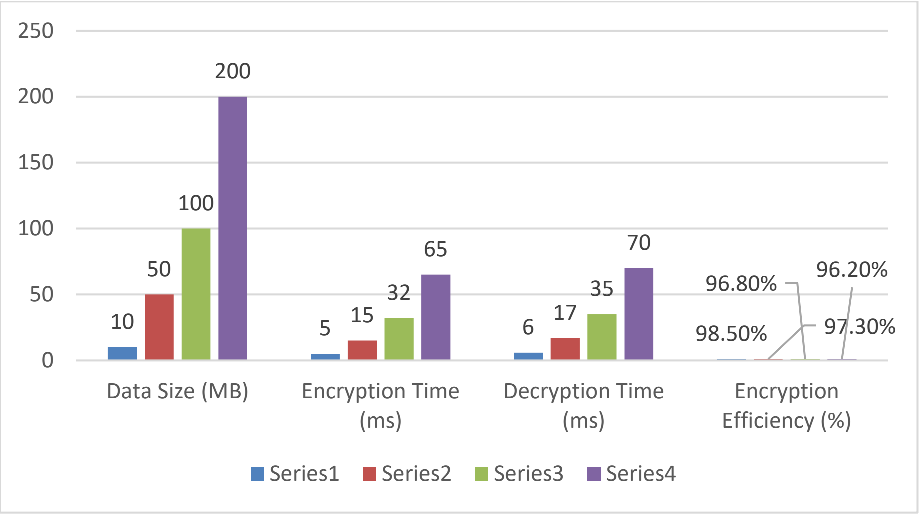

Figure 3: Encryption and Decryption Performance Metrics in P2DS Framework

Figure 3 displays the performance of the Proactive Dynamic Secure Data Scheme (P2DS) concerning various data volumes, emphasising encryption efficiency, decryption speed, and encryption time. There is a natural increase in encryption and decryption times from 10 MB to 200 MB of data. Figure 3 also shows that encryption efficiency remains consistently high, above 96%, even with increasing data quantities. This consistency demonstrates how well the framework can handle massive volumes of data without sacrificing performance. This high efficiency guarantees the quick and safe processing of critical financial data in mobile cloud environments. Overall, figure 3 shows how scalable and effective the P2DS framework is, making it a solid choice for satisfying the changing security requirements of financial institutions.

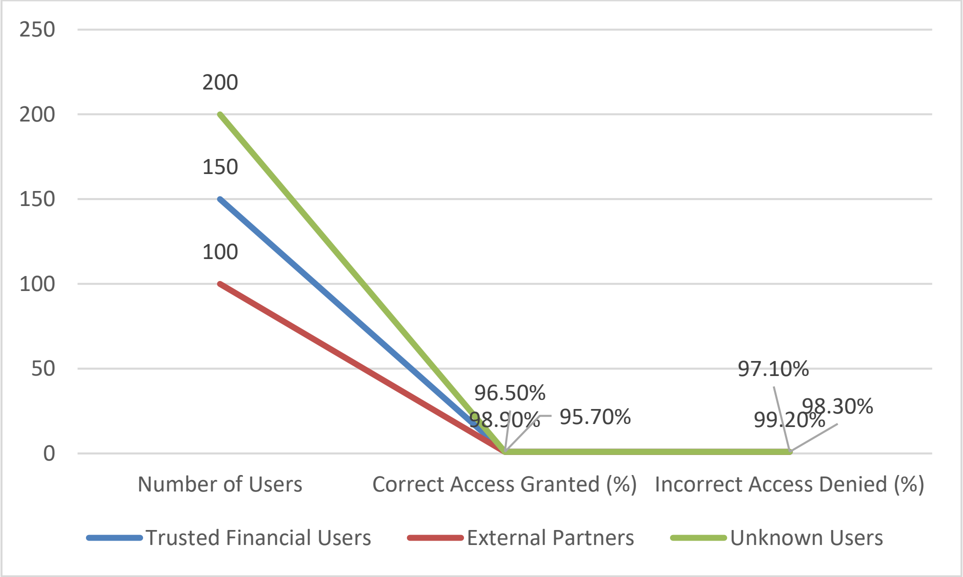

Figure 4: Access Control Accuracy Across User Groups in the P2DS Framework

The Proactive Dynamic Secure Data Scheme (P2DS) access control accuracy is shown in figure 4 for three different user groups: Unknown Users, External Partners, and Trusted Financial Users. The percentage of correct access allowed and wrong access blocked are the two main metrics highlighted in figure 4. With a correct access percentage of 98.9%, Trusted Financial Users lead the field, followed by Unknown Users at 95.7% and External Partners at

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96.5%. For all groups combined, the accuracy of rejecting erroneous access is still high—figures exceeding 97%. Figure 4 clearly illustrates how the P2DS framework manages access control, reducing the possibility of illegal access and guaranteeing that only authorised users have access to critical financial data. The consistent performance across various user groups highlights the strength and dependability of the framework in upholding strict security criteria.

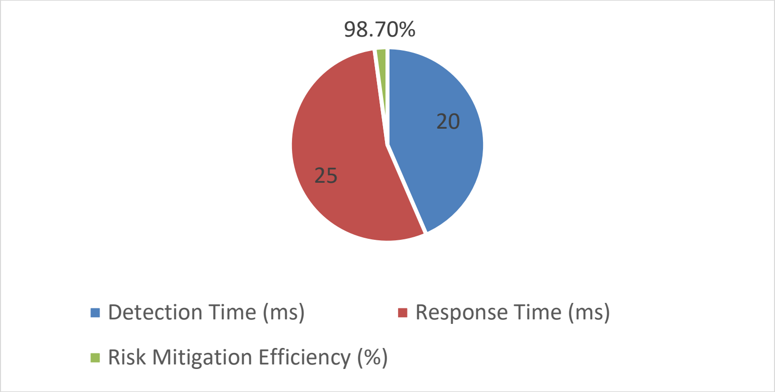

Figure 5: Security Threat Detection and Mitigation Efficiency in P2DS Framework

The effectiveness of the Proactive Dynamic Secure Data Scheme (P2DS) framework in identifying and managing security threats is graphically demonstrated in figure 5. Three primary parameters are the subject of this analysis: detection time, response time, and risk mitigation efficiency. The system can respond rapidly to possible threats, as evidenced by the 20-millisecond detection time and the 25-millisecond response time that follows. The risk mitigation efficiency stands out the most, at an astounding 98.7%. This high efficiency suggests that the P2DS architecture effectively neutralises threats before they can inflict damage. The framework is a dependable option for financial organisations that must safeguard sensitive data from anticipated and unforeseen cyber threats, as figure 5 demonstrates its proactive approach to cybersecurity. The framework's capacity to strike a balance between efficacy and speed—a critical attribute for preserving robust security in dynamic cloud environments—is seen in figure 5.

5 CONCLUSION AND FUTURE PERSPECTIVES

The Proactive Dynamic Secure Data Scheme (P2DS) offers a reliable and efficient method of securing financial data in mobile cloud environments. P2DS guarantees high encryption efficiency, precise access control, and quick threat detection by combining cutting-edge security approaches, including Attribute-Based Encryption (ABE), Attribute-Based Semantic Access Control (A-SAC), and the Proactive Determinative Access (PDA) algorithm. The P2DS framework's capabilities enable financial institutions to safeguard sensitive information and adhere to regulatory standards, making it an excellent fit for their intricate and ever-changing security needs. P2DS, as a whole, represents a significant breakthrough in data security, providing financial organisations with a robust line of defence against the increasingly potent danger of cyberattacks.

The Proactive Dynamic Secure Data Scheme (P2DS) has a lot of exciting things in store for the future. One area with room for improvement is incorporating AI and machine learning to improve the framework's real-time threat detection and response capabilities. Furthermore, modifying the P2DS framework to meet these novel technological obstacles as quantum computing develops could further ensure its efficacy. Enhancing scalability through research will be crucial as financial institutions manage more prominent and more extensive datasets. Lastly, investigating P2DS's applicability in other industries, such as government or healthcare, where data security is essential, may increase its usefulness and influence.

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