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Revolutionizing Cyber Security With Cloud Computing : Security Platforms with Artificial Intelligence and Machine Learning

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Abstract:

Swinging the concept of the state of California in this paper, this paper will analyze the impact of integrating the high-flying SIEM and SOAR with cloud computing, which says that some of them are bigger, more elastic, and way more cost-effective. This would elaborate on how a transition into working over cloud platforms benefits concepts like the SIEM and SOAR solutions over real-time data processing platforms, including how threat intelligence is significantly enhanced. The ability to respond to incidents appears to have achieved a new level. Moreover, there are AI & ML integrated into such systems, bringing threat intelligence, anomaly detection, and predictive security for additional cybersecurity enhancement. They also described the type of cloud-based tools and applications they adopted in their learning and justified the tools they undertook. The paper also provides solutions to new issues, like data protection and data fusion, which are reasonable and practical trends for organizations willing to leverage such technologies and improve security.

Keywords: Cloud, GRC (Governance Risk & Compliance), SIEM (Security Information and Event Management), SOAR (Security Orchestration Automation & Response), AI (Artificial Intelligence), Machine Learning, Cyber Security, Real-time Threat Identification, Automated Remediation, Predictive Analysis, Threats, Data Privacy, Integration, Threat Intelligence, Anomaly Detection, Incident Handling, Cloud Security, Elasticity, Agility and economy, Intelligence.

Introduction

This war remains an ever-evolving process of attacking and defending positions in the pivotal nature of cyber threats, and cloud computing remains one of the critical components of modern strategies. Therefore, based on the mentioned advantages of cloud solutions (scalability, flexibility, cost-saving), organizations have opportunities to manage large amounts of security information and provide adequate processing of these data that will positively affect the state of security in organizations. These cloud computing benefits make it impossible for present-day security architectures to ignore real-time threat identification and participation in incidents and responses (1).

Security Incident and Event Management (SIEM) is a category of solution that is important to an organization's processes of security event collection, analysis, and management in terms of the overall incident handling across the IT infrastructure of an organization. Because of their structure, SIEM systems gather information from various sources, suggest a broad view of the possible sources of danger, and provide possibilities to respond simultaneously with high efficiency (2). The Security Orchestration, Automation, and Response (SOAR) systems go a notch higher by integrating the handling of security incidents using automation and orchestration. Consequently, the advantages that may be assigned to the organizations choosing SOAR platforms are the enhancements of Security Operations and First Response and the productivity boost of the Security Team (3).

The application of AI and ML as enablers that can enhance the SIEM and SOAR systems is one such advancement. Machine learning and artificial intelligence, by improving the capabilities of analysis and early threat recognition, different forms of anomalies, and prediction of possible security breaches help organizations avoid such occurrences becoming more severe. They can learn and develop threat recognition capabilities, which means they remain always current and operational (4). Hence, AI and ML are essential in shifting conventional security architectures to self-acting and adaptive systems.

Cloud Computing in Cybersecurity

Thus, as a new face of technology in cybersecurity, cloud computing has revealed solution scenarios that are far from outdated, easily adjustable, and significantly cheaper than the previously necessary solutions for dealing with present-day security. This allows for growth when this might become vital and for elimination if it is not essential, perhaps making it possible for an organization to handle massive data and integrated security vigilance without bringing about prohibitively expensive arrangements (1). However, it is precious for SMEs who cannot invest off-balance sheets in several on-premises security solutions.

The last but not the most minor factor within the core cues of cybersecurity within the internal cloud computing system is flexibility. The privacy of information in cloud solutions can be realized by choosing one from either one or the other service or tool provided to meet specific security requirements. A vast array of security applications and services can be readily deployed in an organization's security setting. Therefore, it becomes feasible to reach the most enhanced security environment development and adaptability in addressing modern threats and new emerging requirements (2). It also becomes possible to alter and update the measures and instruments in the sphere of security as easily as a person changes the new fashion in the technology field.

However, more emphasis can be placed on the application of cloud computing because it is financially rewarding in too many ways to enumerate. It can, therefore, be seen that in this way, organizations can cut down their expense with the help of cloud services to minimize the cost force in repairing and reconditioning the physical equipment and softwares. With the adoption of this cloud, the consumption of services by the organization happens based on the need and demand, hence the need for better control of the funds to be utilized (3). The onset of this cost model ensures that organizations can attain adequate security measures regardless of their financial worth.

As for the partnership between the SIEM and SOAR systems, the appropriateness of cloud platforms should be similar. Some organizations include cloud-based subscriptions in their offerings of SIEM solutions to take advantage of real-time data processing and analysis, enabling these organizations to be more efficient in tackling security threats as it is observed that the feature of gathering data from multiple sources increases the threats and the level of risk as compared to the large quantity of data entering in the cloud (4). Consequently, different cloud-based SIEM systems could also use analytics with machine learning to recognize these specific trends that may point to a security threat.

Likewise, cloud-based SOAR platforms are beneficial for security operations, especially for the new automated and orchestrated modes. These platforms can also help reduce working time through the complete automation of repetitive tasks, request optimization, and an increase in the response rate of incidents. Since the cloud also improves a collaborative working environment, the flow of proposals and results is successive, thus enhancing the working of the security team (5). Furthermore, knowing that the cloud lies in various regions of the globe gives availability and backup sense; even though a specific region ceases to function, security shall not be compromised since other areas have other requirements.

Advanced SIEM Capabilities

Conventional SIEM solutions have occupied the core of cybersecurity initiatives mainly because they are modeled to continually collect and process security events generated from different segments of an organization's IT environment. They include logs and information from firewalls, IDSs, and servers to present an overview of actions performed relative to security. In this respect, I will be more precise and say that the data gathered by an SIEM system is helpful for the detection of potential security threats in the system, the people who infringe on the rules, or perform other malicious actions (1). They produce event notifications for security issues that the security team acknowledges and addresses.

They should underline that cloud computing offers numerous opportunities to traditional SIEM systems in data processing and real-time data integration. Compared with the on-premise systems, which could often face issues handling large amounts of data quickly, the cloud SIEM solutions could leverage the cloud's virtually unlimited raw computing power to process the data feed in real time. This assists organizations in regulating activities that may be considered unconventional or pose a threat to the security of the organization and be in a position to counteract such or parry likely security threats in the shortest time possible (2). The latter can store data from various scattered sources, making it possible to consider covering and improving the probability of threat identification in the cloud environment.

Threat intelligence is another major added value component incorporated in the cloud-based SIEM systems. SIEM systems based on the Cloud platforms' underlying architecture can share threat intelligence feeds in more than one threat intelligence database worldwide and several third-party security vendors. This integration also improves threat identification; the identified events are compared with even more contextual information deduced from other information inferred on the already identified threats, thus boosting threat detection (3). For instance, every time a system detects an IP address associated with other incidents of similar occurrences of other related malicious activities, the event will be marked for further examination by security specialists.

In this case, it is possible to speak about activities that could be done with the help of cloud computing, such as automated alerting. It would be solved in an upgraded class of cloud-based SIEM systems using algorithms and extensive calculations in machine-superior approaches to classify security threats. It can also help in creating notifications to notify everybody concerning any malicious actions; in this way, the Security Team is not constantly observing misdemeanors but can focus on significant issues. For example, as long the activity associated with login is somewhat above the norm from some geolocation, the SIEM system can alert the security team and possibly proceed with further actions, e.g., IP banning that is suspicious (4).

Secondly, there is another point to note: compared to traditional SIEM systems, cloud-based SIEM systems are even more scalable and flexible. In the long run, the security concerns of an organization change, and this benchmark can be expanded to encompass other information and security parameters if needed. This scalability makes it possible for the definitive organization SIEM system to retain a relative level of optimality regarding effectiveness and efficiency when there is an expansion of the IT framework of the organization (5). Because the cloud is dynamic and evolving, new choices and changes can be integrated into the SIEM system; it will be prepared to counter threats currently out there using the most current instruments and measures for protection.

Advanced SOAR Capabilities

SOAR frameworks are tools designed to enhance security efficiency and enable a better combination of security operations via automation, processes, and other standardized approaches to core responses to various threats. SOAR solutions integrate multiple security devices and allow security engineers to manage from within a single software program of attacks and responses. This configuration means that the SOAR systems can schedule general tasks to be executed automatically. At the same time, the security technicians deal with more complicated issues related to the increase in efficiency and the response of the SOC (1).

The following primary considerations regarding the benefits of using SOAR in the cloud are presented: The first is related to the extent of the possibility of exchanging data between the project participants. Integrated solutions containing SOAR platforms are always cloud-based to enable working from various locations within security teams. This is appropriate for companies that centralize and decentralize their operations or those with an international dimension. In this case, the cloud environment also offers flexible and responsive collaborative communication to every member to get better views of the current threat intelligence and the incident (2). This model enables all the students to handle such incidents and reduces the time often taken to resolve security incidents.

The final advantage of adopting cloud-based SOAR is mitigating response time between the security team and the used SOAR tool. In fact, by incorporating the cloud features in the SOAR platforms, the data collection and analysis processes are convenient because of the facilities offered by cloud computing. This real-time data processing capability enables the system to learn of the threats and risks quickly and respond immediately to avoid incidents of insecurity and its consequences (3). On the same note, there are pros to using cloud-based SOAR platforms, such as the fact that it incorporate analytic and machine learning features; thereby, the SOAR will be able to study the incidents and discern what is crucial for attention.

A few of the functions in the SOAR model are likely to yield a lot better performance if executed in the cloud computing setting. It is one of the functionalities that can be automated to address any event in the system. Thus, thanks to popular cloud-based SOAR systems, it is possible to introduce automation at each stage of incident response. This range includes isolating affected systems, black-listing IP addresses belonging to malicious IPSs, and applying patches or upgrades. In this way, the organizations can reduce the effort that would otherwise be required in dealing with the tasks and, more to the point, ensure that the occurrences are identified and addressed following procedure (4).

This is also presented as an enhancement of function from cloud computing, considering the playbook's execution. On the related SOAR platform, multiple playbooks point to the action and procedure plans applied following the type of security incidents. Thus, the Cloud-based SOAR systems can execute these playbooks and ensure that the most appropriate processes for each event are undertaken. It is also versatile in that it allows updating and scaling the playbooks in the cloud, which means the playbooks can adapt to emerging threats and the adaptive needs of an organization (5). For instance, taking action on a discovered phishing attack may include isolating the email account used in the attack, looking for other accounts that could be exploited, and informing the affected persons.

Besides the automatic reaction to the incident and the productivity of the playbook, SOAR in the cloud may have more functionality and distinct results. Cloud environments also have solutions for managing logs and reporting all security activities to give the organization a comprehensive view of its security status. The components include decision support tools like advanced analytics and visualization, which can be used to prepare reports and smart dashboards for security officers and executive management, which can help in the right approach to security (6).

The Importance of Artificial Intelligence and Machine Learning

Nowadays, AI and ML are employed in various tasks, small, significant, helpful, and disastrous.

AI and Machine Learning progress has intensified SIEM and SOAR platforms and drastically enhanced both branches' efficiency. When used in these systems, AI and ML help organizations add the features of extensive data analysis and automation and forecast functionalities that improve the general cybersecurity posture of an organization.

Best to Integrate Machine Learning and Artificial Intelligence with Security Information and Event Management and Security Orchestration, Automation, and Response Intro: How to integrate AI and ML technologies into the SIEM and SOAR systems to enhance them and enhance their effectiveness and productivity. In SIEM systems, AI and ML are also used to process large amounts of security data needed to identify new patterns indicative of new threats. Such algorithms can be used to develop knowledge based on the past security incident data set, including IOCs with the desired ability to predict future attacks. For instance, while using an ML approach to identify intrusions in a given network, the models can update themselves from time to time by incorporating new data, thus improving the models' efficiency or incorporating new types of threats (1).

By leveraging the deployment of AI and ML, SOAR systems support intelligent decision-making. A primary benefit of employing an ML model is that it can assist in classifying incidents concerning the amount of threat they present. It can, therefore, be used to categorize the risks so that the most threatening types can be addressed first. AI in playbooks means that an event is handled with response actions suitable for the threat identified, given that there is no input from people. Thirdly, AI and ML are useful in the overall management of the event timeline across different security appliances, so there is a better understanding of the threats in the network and how they should be addressed (2).

Benefits of utilizing AI & ML

Integrating AI and ML into SIEM and SOAR systems offers several key benefits. The opportunities of integrating AI and ML into SIEM and SOAR are the following:

Improved Threat Detection: AI ML techniques utilize large quantities of data to identify perils that would be impossible to locate utilizing classic rule-bound procedures. These algorithms can learn from the new data and thus can instantly identify other previously unseen threats (3).

Anomaly Detection: The loudness measure can successfully identify that security data is anomalously accented by increased access patterns or traffic patterns. These are typical signs that indicate that some mischief in cyber has occurred; action can be initiated and thus be completed before much harm is inflicted (4).

Predictive Analytics: AI and ML also imply that an organization can assess and perhaps foresee any adverse occasions that may befall the business or even the whole world and avoid them. Thus, since the analysis of past data and the calculation of a trend are the critical aspects of ML algorithms, it is possible to predict additional attempts that may pose a threat to security and, thus, recommend increasing the security level (5).

Case Studies and Examples

Improved Threat Detection at XYZ Corporation: To further illustrate the enhancement of threat detectability with technology, it is essential to discuss the implementation of AI and ML within an organization, specifically the XYZ Corporation SIEM system. The authors were able to use such simple and easily understandable algorithms to parse through network traffic data and identify very complex attacks that would usually be invisible to analysis. Doing that helped the organization to reduce the time taken to go through the cycle of threat detection and response by 40% (6).

Automated Incident Response at ABC Enterprises: A cloud-based SOAR platform augmented with AI and ML capabilities was developed regarding ABC Enterprises. They employed AI-playing books, which provided a template of how to act when an incident occurred, for example, quarantining other infected end-user devices or blocking the IP addresses of known adversaries. It cuts down the average time to respond to such occurrences from hours to minutes, thus minimizing the impact of secure threats (7).

Anomaly Detection at DEF Financial Services: Since SIEM processes are frequently related to end-user monitoring, DEF Financial Services also used ML models to detect user behavior deviations in the SIEM context. The first was the customer alerts of the login pattern being different from the usual ones, and the second was alerting the customer to their account possibly being compromised. After demarcating these anomalies, DEF Financial Services was able to solve cases of attempted penetrations that could leak customers' sensitive information earlier (8).

Real-Time Scenarios
To further elaborate on the concept and how solutions like the cloud-based SIEM and SOAR incorporate AI and ML, one could use actual-time data and cyber-attack examples to create scenarios demonstrating how the solutions work. These scenarios will explain how these integrated prospects can efficiently recognize, evaluate, and mitigate threats.

Scenario 1: This has been seen to lead to the identification of phishing attacks on the target's online social platforms and their action.
Situation: A typical scenario relates to an employee receiving a message containing a link or an attachment from the financial institution's legitimate vendor, but the message is a phishing email. An email is received with an embedded link, and when the link is clicked, its purpose is to gain the employee's login details.

Detection:
SIEM Analysis: Cloud-based SIEM augmented with AI and ML remains continually vigilant of email traffic and its use. Fortunately, there are artificial intelligence algorithms that can detect phishing messages. Based on an analysis of the headers of the received message, a specific decision will be made that corresponds to the characteristics of phishing messages.

Anomaly Detection: The ML models are introduced for such features and to alert the staff, observing that the email is received from an unknown, malicious IP of the vendor.
Response:

Automated Alert: Based on the analyzed data, the SIEM system generates an alert, which is then forwarded as a notification to the SOAR platform.

Playbook Execution: • The PC SOAR system has a specific planned approach to the phishing attacks. The playbook specifies what action should be taken: changing the password on the account of the affected employee, suspending the account, and blocking the associated IP address.

Incident Reporting: The entire reporting process under the SOAR system includes filing the incident report and informing the security team and other individuals. Outcome: The phishing attempt is nipped in the bud before the employee loses their identity and other complicities of data breaches, including monetary losses, come into the fray.

Scenario 2: Examples of a cybersecurity threat could include a ransomware attack on a healthcare firm.
Situation: A healthcare organization is successfully breached, and the patient data is encrypted by the attacker, who keeps the decryption key for ransom.

Detection:
SIEM Monitoring: An instance of a cloud-based SIEM system with the assistance of AI and ML recognizes the usual file encryption activities in one or many endpoints.

Threat Intelligence Integration: The analyzed activity is compared with the threat intelligence information from global sources. Based on the analysis, the SIEM system concludes that the conjectured activity is ransomware.

Response:
Automated Containment: The SOAR platform receives a notification of an attack and then tries to mitigate the attack by

coordinating an action. This involves isolating such endpoints from the network to prevent them from moving to other areas of the network.

Data Recovery: The SOAR system executes a script that presents different sections about beginning data restoration from the most recent backups.

Communication and Reporting: Standard processes include following a lengthy process that entails providing an update to a person or a group of persons, like the incident response team, regarding the incident. It also generates some critical reports to ensure that various rules and regulations in the health sector are met.

Outcome: This type of attack – ransomware – is categorized and isolated immediately; therefore, most of the data and operations' interference should be prevented. This also means that the organization can have the stolen data encrypted by the hackers and recovered from backup without having to pay anything to these hackers.

Scenario 3: DDoS ATTACK ON E-COMMERCE: A CYBER SECURITY THREAT SCANNING

Situation: A DDoS attack is conducted by sending traffic to one or several e-commerce platforms to overload the servers and minimize the provision of services.

Detection:

SIEM Real-Time Analysis: The innovative cloud-based SIEM with AI and ML integration suddenly identifies large traffic volumes directed at the e-commerce platform servers.

Pattern Recognition: The signature-based ML algorithms identify the traffic pattern matching earlier occurrences of DDoS attacks.

Response:

Traffic Filtering: This generates alerts to the SOAR system and executes a DDoS mitigation playbook. In this method, the traffic is rerouted to a traffic scrubbing center within the cloud network.

Resource Scaling: The SOAR platform operates concurrently with cloud computing to summon extra server resources to address elevating load and ensure service delivery continuity.

Alert and Mitigation: The SOAR system alerts the security team and continues the analysis of traffic to adapt the solution if needed.

Outcome: An attack, particularly a DDoS, is defended with minimum actions on the e-commerce site. Customers frequently consume information and services without moderate interference while maintaining the website's functionality.

Conclusion

These are samples of how the cloud-based SIEM and SOAR platforms augmented with AI and ML can recognize and counter various threats. They are integrated systems that provide end-to-end solutions based on the interaction with attacks, the use of real-time data, and practical analysis to preserve the organizational processes and defend them against some higher-level forms of cyber threats.

Countermeasures of Phishing Attacks (Analyzing Graph Data)

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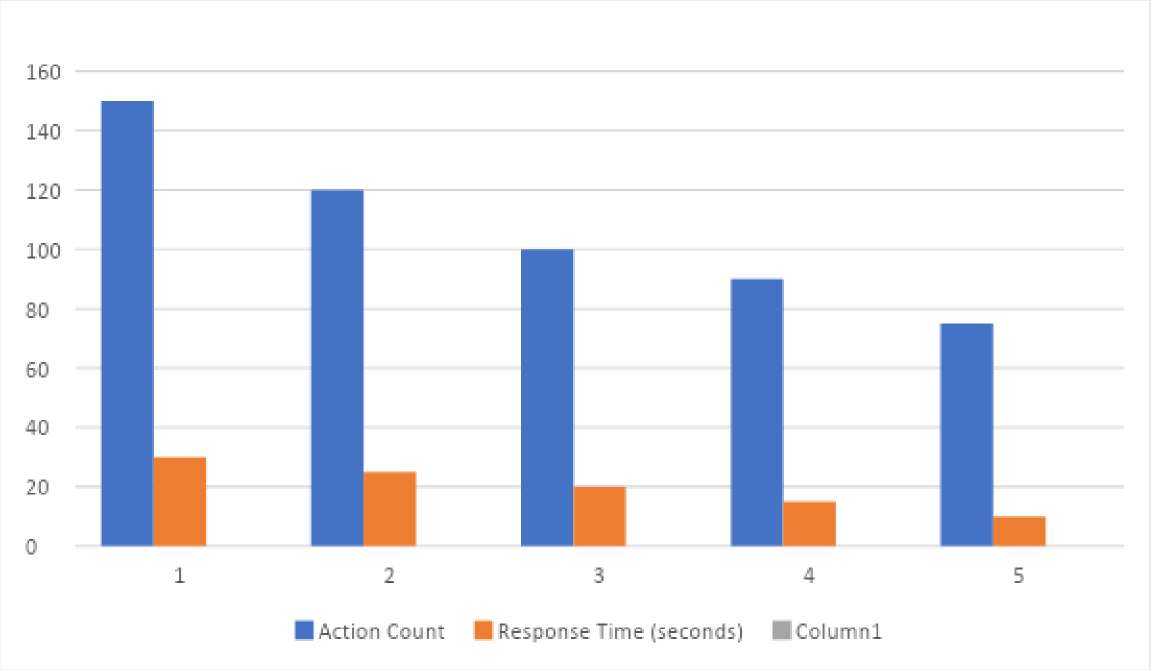
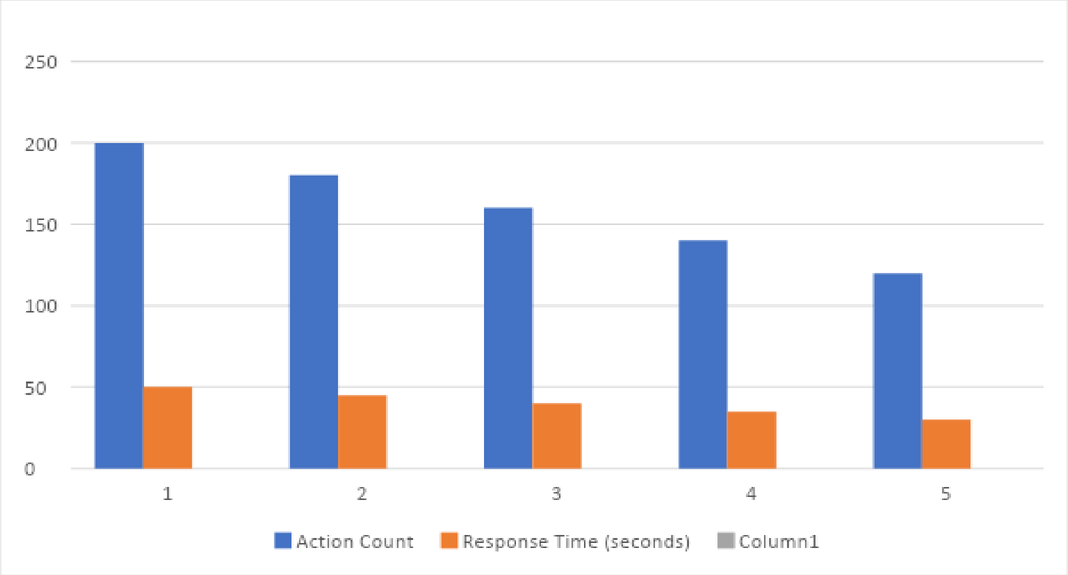
Step	Action Count	Response Time (seconds)
1	150	30
2	120	25
3	100	20

4	90	15
5	75	10



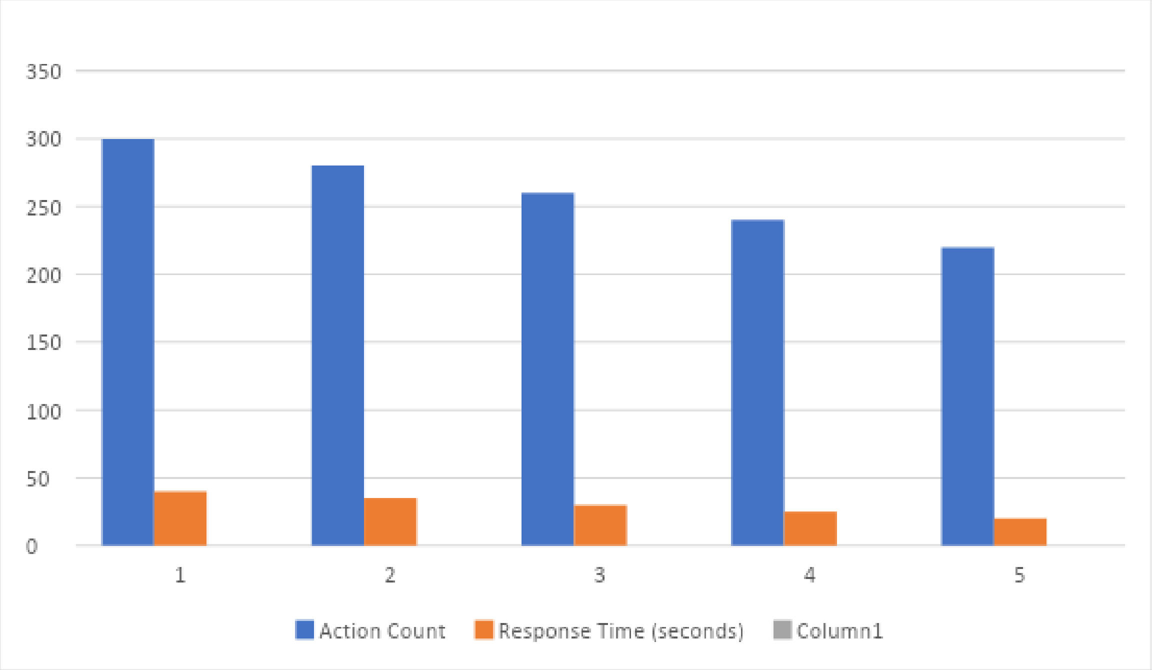
Graph Data: Ransomware Attack Detection and Response

Step	Action Count	Response Time (seconds)
1	200	50
2	180	45
3	160	40
4	140	35
5	120	30



DDoS Attack Detection and Response (Graph Data)

Step	Action Count	Response Time (seconds)
1	300	40
2	280	35
3	260	30
4	240	25
5	220	20



Challenges and Solutions

Cloud computing in SIEM & SOAR: New concerns

Data Privacy:

Challenge: Companies must regulate the security of cloud-based SIEM and SOAR tools containing sensitive information. Said models expose the data stored and processed within the cloud environment to access or data violations by unauthorized personnel, which are inapposite to data protection laws and policies (1).

Solution: Others would use robust encryption procedures for data frames to be stored and transported. Lease key and, more importantly, utilize key which can be controlled from outside rather than the organization owning it. Ensure the cloud provider complies with data protection regulation standards such as the General Data Protection Regulation or Health Insurance Portability and Accountability Act (2).

Security Concerns:

Challenge: However, it is also essential to understand some risks undertaken by the cloud environment: they are risks from shared infrastructure, risks from insiders, and risks from dispersed data (3).

Solution: Explain the MFA process in addressing the security measures; Perform the security assessment from time to time; Leverage the employment of SIEM coupled with the SOAR policies as part of the security procedures effectively. Implement the zero-trust model to authenticate and authorize users and their devices on each level and at any instance (4).

Integration Issues:

Challenge: The use of cloud-based services in SIEM and SOAR solutions may present the problem of compatibility with existing on-premises security solutions and apps (5).

Solution: Specific interfaces or APIs accompanied by strictly conformed protocols must be used for integration. When selecting the SIEM and SOAR, ensure that the tools chosen have good integration properties to integrate with the other applications and tools in the security domain. This means one should involve integration support and service suppliers to address the following objectives listed under option number six.

Recommendations for Organizations
Conduct Thorough Assessments:
Therefore, before migrating to the cloud, enterprises should assess the current security position and potential and identify the needs for cloud-based SIEM and SOAR solutions. This also includes evaluating the probability of protected data, the current security systems and solutions, and potential and existing interconnections (7).

Choose Reputable Cloud Providers:
One should go for those cloud vendors who have been proven trustworthy in terms of security and should be standard-compliant. Review the security states offered by the provider, its certifications, and policies concerning adherence to the legislation of the standard carrier. Regarding services, it is advisable only to consider those providers who offer comprehensive security services and solutions (6). Implement Strong Access Controls:

Other ways of suitable physical control include ensuring that only authorized persons can access the company's secrets. On the cloud factor, SIEM and SOAR provide guards for all users with multi-factor authentication. It states that the policies define which users should have access to which parts of the system and can be frequently revised to minimize the chance of hacking into the system (9). Regularly Update and Patch Systems: It is crucial to update periodically and patch systems:

Make sure that all cloud SIEM and SOAR systems are updated with the latest patch and updated to be deployed for all integrated security tools. Ensure the settings are updated and perform audits from time to time to seek any probable risks to address (10). Provide Training and Awareness:

Educate security teams and other employees about the specific cloud-based SIEM and SOAR systems and what they can do. This can be done by implementing programs where people will be educated on the various dangers that exist to the firm and how to handle them and measures to be taken to minimize data loss (11).

Monitor and Audit Continuously:
Perform at least continuous and direct evaluations of the adapted cloud-based SIEM and SOAR frameworks and their accordance with the rest of the security management systems to provide real-time security threat identification and the proper corresponding response. The following prevention techniques should be employed: event generators/monitors should be used to create alerts and reports, and IT personnel should periodically conduct security reviews to ensure they comply with internal and external security standards (12).

Conclusion

This work has reviewed cloud computing with high SIEM and SOAR with much emphasis on AI and ML in this project in a rather vivid manner. The prospects for improving the cybersecurity perspective are also excellent for organizations with the help of the many features such as scalability, flexibility, and cost-saving solutions offered by the cloud platforms.

Thus, applying AI and ML together with SIEM and SOAR results in the following benefits: threat identification, anomaly identification, and predictive analytics, among others. These technologies make it possible to immediately monitor and analyze a large amount of data, respond to threats with decision-making, and receive high-quality intelligence – a prerequisite for combating modern threats. Other real-world examples, such as phishing, ransomware, and DDoS attacks, provide insights into the performance and feasibility of these interconnected systems to refine the threat detection, assessment, and mitigation method with less interruption.

Still, adopting cloud-based SIEM and SOAR systems is not without some problems or issues. When implementing these technologies, the following facts must be considered. Here, issues like data privacy, security, and integration, which are crucial in implementing proper technologies, must be well managed. However, these challenges are solvable through proper encryption, appropriate security measures, practicing standardized integration protocols, and opting for the best cloud providers.

Some recommendations that organizations implementing cloud-based SIEM and SOAR systems should consider include A proper analysis of various essential security necessities, user and administrator secure access policy, regular system updates/patches, user training and awareness, and adequate system security monitoring and auditing. Organizations will attain the suitable capacity to deploy these intelligent technologies to mitigate emerging risks by setting up these measures.

Therefore, when implemented alongside AI and ML, cloud computing solutions further SIEM and SOAR advancements offer a robust response to current cybersecurity challenges. Avoiding possible issues and following the best practices significantly increase operational capabilities of identifying, preventing, and combating threats and security incidences, as well as trying to shield the primary resources and preserve the necessary organizational soundness of the frameworks.

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